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Radio-Activity and Radium.

By W. A. SHENSTONE, F.R.S.

II.

THE discovery that radium gives off, unceasingly, the radiations discussed a little later, and the early observation that in many respects these resemble the Röntgen or X-rays naturally suggested that possibly a few milligrams of radium might advantageously replace the comparatively complicated equipment required for the so-called X-ray photography, and accordingly this very interesting side of the subject has excited some interest. Whether radium rays will ever replace the usual apparatus for the production of Röntgen rays remains to be seen. But some very interesting results have undoubtedly been obtained, as my readers will gather from the following series of very excellent radium radiographs which I am allowed to introduce by the kind permission of Mrs. Gifford, of Chard, who has been working on this subject with great success. The conditions are given under each plate. Fifty milligrams of highly-purified radium bromide in glass tubes were used.

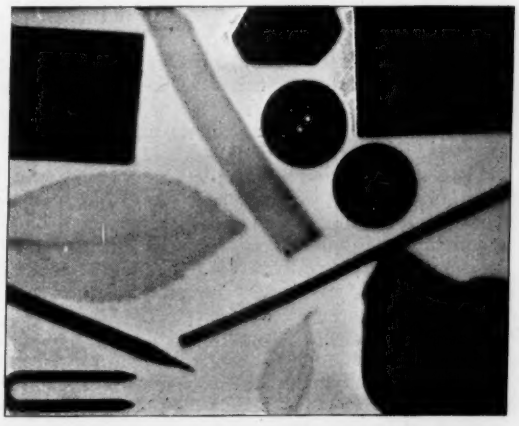


FIG. 6.—The radium salt was enclosed in two light bags. Exposure, 24 hours, at a distance of 9·65 cm. Medium plate. Most of the objects will explain themselves. The rectangular figures at the top are produced by blocks of glass, that to the right by uranium glass. The crystal near the larger block was fluor spar, the amorphous mass at the bottom on the reader's right is Kauri gum.

The trouble which arises in regard to the use of radium salts for work of this kind, I am informed, is this:—That it is difficult, if not impossible, to concentrate the acting salt into a sufficiently small space. The radiations used, in short, are too diffuse.

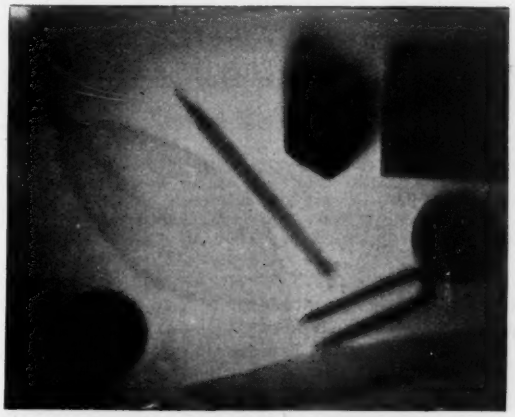


FIG. 7.—Taken under much the same conditions as 6, but through a plate of aluminium and with a 10 hours' exposure.

The distinctive characters of radium which were first recognised were what are commonly known as "its radiations." But almost more wonderful and mysterious than these is the "emanation," which has been so carefully studied by Professor Rutherford, of Montreal.

The Radiations of Radium.—These have been classified as α, β, and γ rays. The last resemble Röntgen rays. They are unaffected by a magnetic field, and are intensely penetrative, passing through sheets of lead of considerable thickness, and these rays alone of the radium rays can penetrate the eyelids freely, so that they can be identified by the sense of diffuse light, of which one becomes conscious when a few milligrams of a radium salt are held near the tightly closed eye in a dark room.

One of the greatest achievements in physics during the latter half of the nineteenth century was the discovery, by Prof. J. J. Thomson, of Cambridge, and his colleagues, in the cathode stream of the Crookes' vacuum tube, of particles so small that about 700 of them would be required to produce a mass equal to that of an atom of hydrogen. These particles carry negative charges of electricity, and so are deflected by magnets; they will pass through thin sheets of metal, cause damp, dust-free air to form mist, and they make air conduct electricity. They move with a velocity equal to one-tenth that of light. They are often called "Electrons."* Now the

* This term was originally applied to the charge of electricity carried by an atom of hydrogen in electrolysis.

XUM

β rays of radium exhibit just these properties, only they move even more rapidly, sometimes, indeed, several times as rapidly as the electrons in the cathode stream, and are more penetrative. Hence the β rays may be considered to be "electrons."

The α rays were the last discovered. These are far heavier than the others, and are very easily stopped.

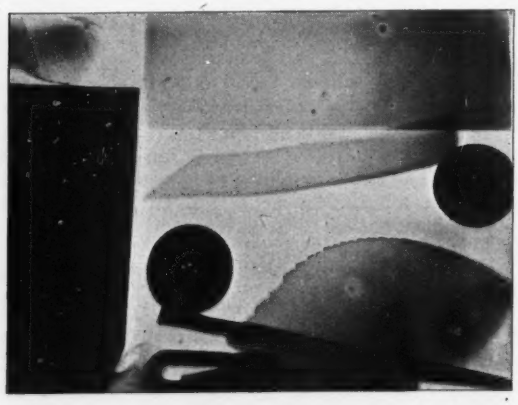


FIG. 8.—Taken without bags, at a distance of 4 cm. and with 5 hours' exposure. The dark shadow on the reader's left was produced by uranium; above it was a crystal of fluor spar. The rectangle at the top was caused by glass, and the dark object below this was a threepenny bit.

They can be deflected by powerful magnets, and the deflection is in the opposite sense to that of the rays of the cathode stream, which shows they carry positive charges. Sir William Crookes has shown us how to recognise them by letting them strike screens covered with phosphorescent zinc sulphide, as in the "spinthariscope."

Such substances as fluor-spar, kunzite, diamond, willemite, and barium platino-cyanide become luminous

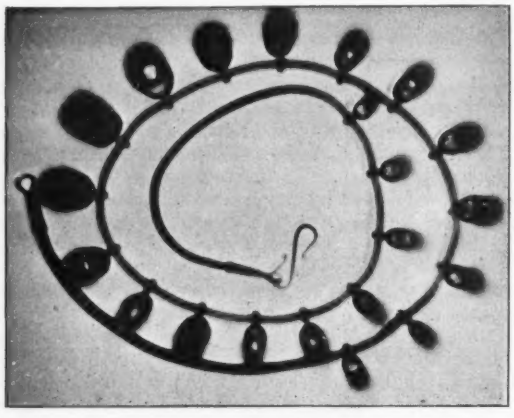


FIG 9.—A necklace of various jewels set in metal. No bag. Taken with a rapid plate in three and half hours at a distance of 4·4 cm.

if the rays of radium fall upon them, much as they do under the influence of cathode rays, the effects produced being exceedingly beautiful.

The Emanation of Radium.—If radium be heated strongly, or if it be dissolved in water, a substance is given off which mixes with gases, and which, when freed from impurities, has the properties of a gas. This substance can be condensed at the temperature of liquid air in a glass tube, and is then phosphorescent. It can be re-evaporated. Its removal deprives the radium of 70 per cent. of its heating power, and the energy of the emanation is so great that it is calculated that if a whole cubic centimetre could be collected in one place it would probably melt the containing vessel. It is radio-active, and therefore must be supposed to be in a state of change, like radium.

The transformation of radium into its emanation and the connection between this change and the radio-active phenomena which accompany it have been investigated by Professor Rutherford. The phenomenon, as it appears to him, occurs in several successive stages. The heavy atoms—for radium has very heavy atoms—of radium disintregrate, throwing off positively charged particles, whose masses compare with those of hydrogen atoms, whilst new forms of matter lighter than radium remain behind, occluded as it were in the remaining radium. These residues are also radio-active and undergo further change of a similar kind stage after stage until at last α, β, and γ rays are all expelled.

Professor Rutherford suggested on certain grounds that probably helium would be found among the products of the disintegration of radium, which led Sir William Ramsay and Mr. Soddy to seek it. They find that though the

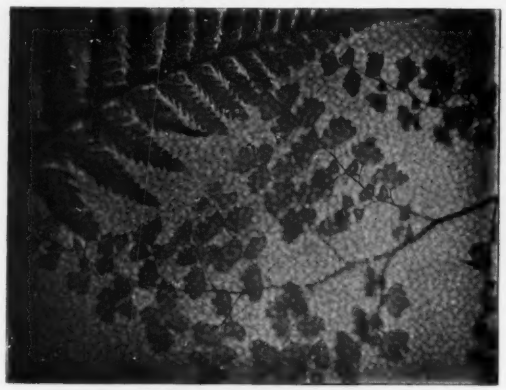


FIG. 10.—No bag was used in this case. Rapid plate. Distance 4·4 cm. Time of exposure, two hours.

emanation of radium when first liberated by dissolving a radium salt in water contains no helium, yet this element may be detected in the same emanation after a few days. For the present, therefore, we regard helium as the ultimate product of the disintegration of radium, or at least as the only such product yet detected.

The discovery of radium and of its unique properties raises some important questions:—

1.—Whence does radium derive its vast supply of energy? It has been suggested by some that it acts as a transformer, picking up energy in some way from its environment and giving it out again as light, heat, &c., in the course of its disintegration. Another school (and this predominates at present) regards radium as a form of matter endowed with relatively vast stores of potential energy; and it has even been suggested, originally, I believe, in order to compose certain differences between the physicists and the geologists on the subject of the age of the sun, that the energy of the sun would be accounted for by the presence of no more than three or four grams of radium in each cubic metre of its substance. Though, except such evidence as may be derived from the presence of helium in the sun, we have not much actual fact to support this latter hypothesis.

One of the latest contributors to this most interesting problem is Lord Kelvin, who finds the second hypothesis

difficult to accept, and points out that if two globular flasks, such as those in figure 12, one containing a black cloth A and the other a white one B be plunged in vessels of water and exposed to a source of radiant heat such as the sun, then the water in the vessel surrounding A will be hotter than that surrounding B, so long as the experiment is continued; as may be proved by the pressure on the mercury at C, or by observing thermometers placed near A and B.

FIG. 11.—Time, eight and a half hours. Distance about 7 cm.

Now the suggestion is that radium salts may absorb energy in this sort of way from some radiation in the surrounding ether, and that we know far too little as yet about radium and about the wave disturbances in the ether to dismiss this explanation of the mystery of radium from consideration before further experiments have been made.

2.—Is the production of helium from radium "a transmutation"; does it foreshadow similar transmutations among the better known and more plentiful elements, *e.g.*, the transforming of lead into gold or *vice versâ*?

It is, I fear, impossible to consider the question in this form seriously till we know much more about radium.

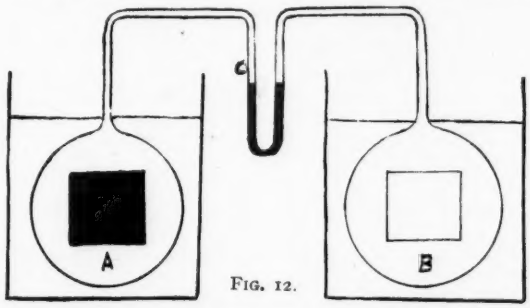


FIG. 12.

On account of its spectrum, the character of its salts, and their general alliance with the calcium group, radium ranks as an element. Yet if we are exact we cannot truly say radium has never been decomposed, for we explain its most characteristic properties by supposing that every specimen of radium salt is disintegrating spontaneously and resolving itself gradually into other forms of matter. Hence, it can hardly be regarded as an element in the sense in which oxygen is considered to be an element at this moment. The question before us, therefore, is this—Are the other elements radio-active like radium and its companions? Do these also, though we do not yet recognise the fact, undergo similar transformations, only at a far slower rate? If they do, or if we can prove that some of the lighter elements, *e.g.*, oxygen, sulphur, or sodium, do so, then the whole question of the nature of the elements, the very basis of chemistry, must come up for revision. At present the position may be taken, provisionally, to be something of this kind. The elements may, for the moment, be divided into two classes.

(*a*) Those which have relatively light atoms, and which are not, so far as we know at present, subject to disintegration, and are not radio-active, such elements, for example, as helium, oxygen, sodium.

(*b*) The radio active forms of matter such as radium, uranium, thorium, which exist in larger particles and exhibit many of the characters of the elements, but which disintegrate, throwing off among their products atoms of elements of the more familiar type.

Whatever the truth may be, and it seems likely we may long seek the answer to this big question, it is clear that the study of radio-active matter must greatly enlarge, even if it does not revolutionise, our ideas about the processes by which the older and more familiar elements have been generated.

The Structure of Crystals.

By HAROLD HILTON.

IT is proposed in this paper to give a brief account of the modern geometrical theory of crystal structure. The units of which a homogeneous medium is composed are called "molecules"; they are either chemical molecules

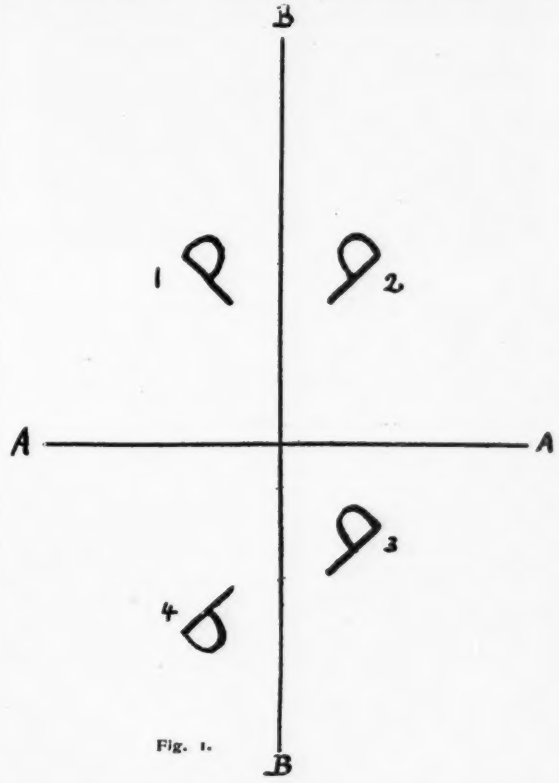


Fig. 1.

or definite aggregates of these. The molecules of such a medium are either all of the same kind (of the same size, shape, &c.); or else they are half of one kind and half of another, the molecules of the two kinds being related in the same way as a right-handed and a left-handed glove, that is, two molecules of different kinds may be placed so that they are reflections of each other in some plane. The two kinds of molecules are represented in the diagrams by the letters p and q. The molecules of the medium are arranged according to certain laws of "symmetry," that is, every molecule of the medium

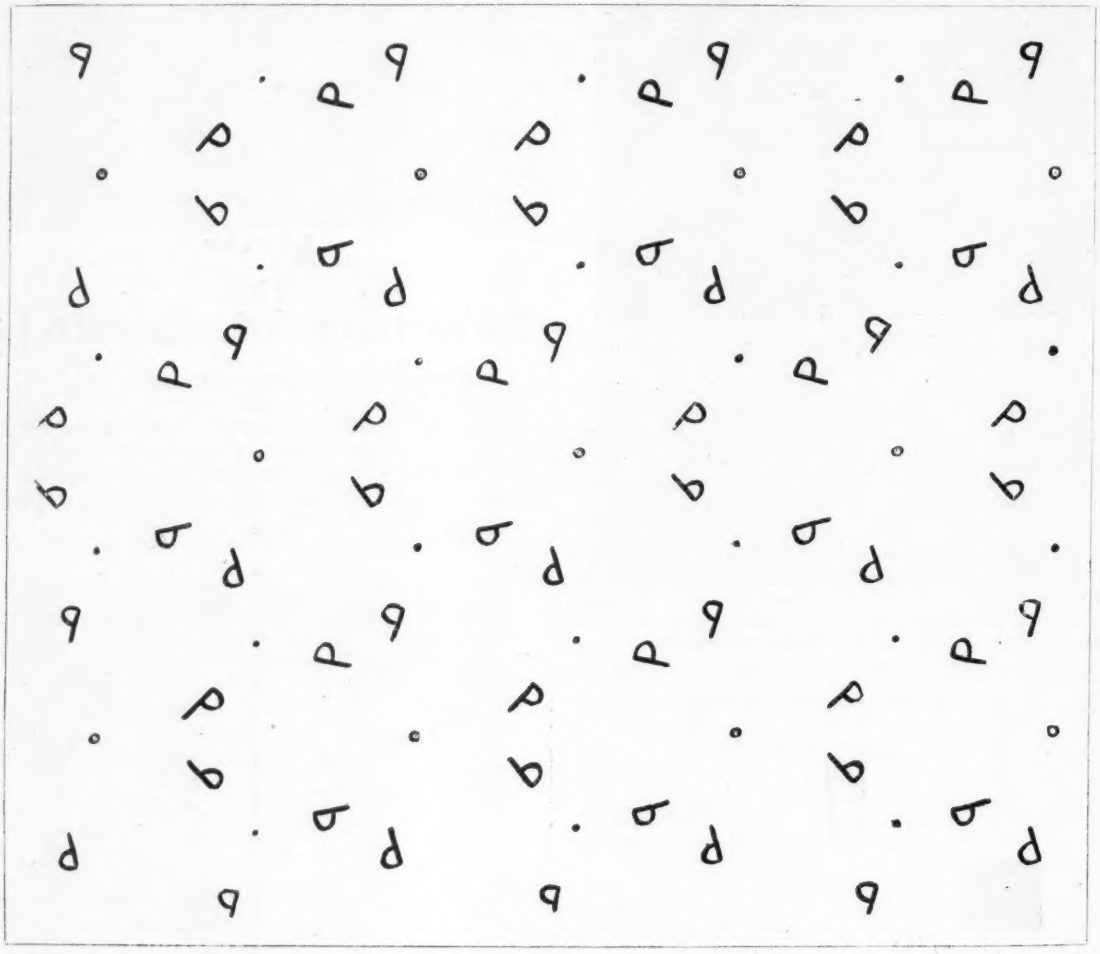


Fig. 2.

(supposed of infinite extent in all directions) is brought by certain so-called "movements" into the position previously occupied by some other molecule of the medium (the medium is said to be "brought to self-coincidence" by such a movement). These movements are of seven different kinds:—(1) a translation, *i.e.*, a shifting of each point of the medium through the same distance in the same direction; (2) a rotation through an angle α, about a straight line called a "rotation-axis"; (3) a screw, *i.e.*, a rotation through an angle α, about a straight line called a "screw-axis" followed by a translation through a distance t parallel to the axis; (4) a reflexion in a plane called a "symmetry-plane"; (5) a reflexion in a point called a "centre of symmetry"; (6) a gliding reflexion, *i.e.*, a reflexion in a plane (called a "gliding-plane") followed by a translation parallel to the plane; (7) a rotation through an angle α about a line followed by a reflexion in a plane perpendicular to the line. Each of these movements leaves unaltered the distance between two given molecules; they may be considered as equivalent to only two distinct movements, (1) and (2) being particular cases of (3) and (4), (5), and (6) of (7). The movements are illustrated by figure 1 in which the molecule 1 is brought into the positions now occupied by molecules 2, 4 by reflexion in the planes B, A (perpendicular to the plane of the paper); and into the position of molecule 3 by a gliding reflexion in B. The molecule 2 is brought into the position of molecule 3 by a translation, and of molecule 4 by a rotation through 180° about the intersection of A and B. A medium may be brought to self-coincidence by an indefinite number of different movements, but the presence of certain symmetry-elements

(*i.e.*, rotation-axes, screw-axes, &c.) necessitates or prevents the existence of other elements. For example, if a medium is brought to self-coincidence by a gliding-reflexion in a plane, it must be also brought to self-coincidence by a translation parallel to that plane. It is assumed that every crystalline medium is brought to self-coincidence by three very small but finite translations not lying in the same plane—a fundamental hypothesis which is justified by remembering that the physical properties of a homogeneous crystalline medium *in a given direction* are the same in every part of the medium. It follows from this assumption that the angle α of movements (2), (3), (7) must be a multiple of 60° or of 90°. It may be shown that the number of distinct arrangements of symmetry-elements is 230—a geometrical problem solved independently by Fedorow, Schoenflies, and Barlow. One such arrangement is shown in figure 2. The system of molecules there given is supposed extended indefinitely in the plane of the diagram, and over and under it at distances 2z, 4z, 6z, . . . are placed similar and similarly situated systems so as to fill all space. It is evident that the collection of molecules so formed has the lines perpendicular to the plane of the paper, and passing through the points marked ○ and ● as rotation-axes ($\alpha = 120°$), has the planes parallel to these axes, and passing through any two adjacent points marked ○ for symmetry-planes, and has the planes half-way between these symmetry-planes as gliding-planes. Such a collection of molecules is one of the six different geometrically possible ways of representing the structure of a medium (such as tourmaline, potassium bromate, &c.), which crystallizes in polyhedra having a rotation-axis for which $\alpha = 120°$ and three symmetry-planes through that axis making angles of 60° with each other (and having no other symmetry-element).

Again, suppose that half-way between two neighbouring systems of molecules in the collection just described, we insert the system obtained by rotating figure 2 through 180° about one of the points marked ○. The collection has the lines perpendicular to the plane of the diagram, and passing through the points marked ● as rotation axes for which $\alpha = 120°$, the lines perpendicular to the planes of the diagram, and passing through the points marked ○ as screw-axes for which $\alpha = 60°$ and $t = z$, and the lines half-way between any two adjacent rotation-axes as screw-axes, for which $\alpha = 180°$ and $t = z$. The collection has the same symmetry-planes and gliding-planes as in the previous case, and has also gliding-planes through the screw-axes perpendicular to the symmetry-planes. The collection is one of the four different geometrically possible ways of representing the structure of a medium (such as zincite, wurtzite, iodyrite, &c.), which crystallizes in polyhedra having a rotation-axis for which $\alpha = 60°$ and six symmetry-planes through that axis making angles of 30° with each other.

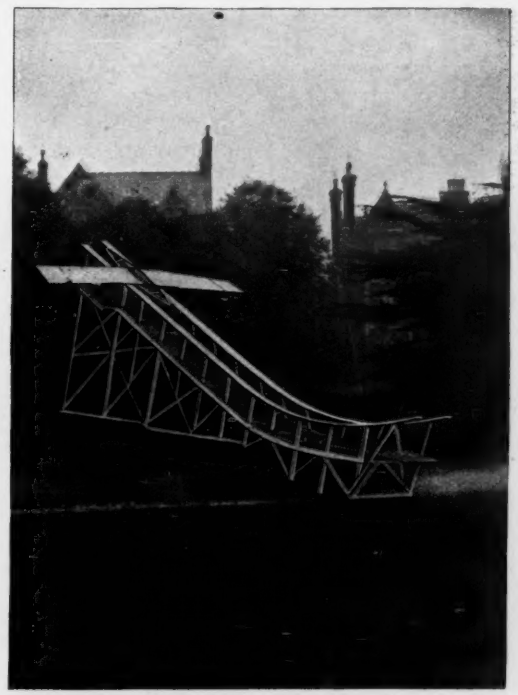
It must be remembered that it has not been proved that a collection of molecules, such as has been described, is one which can exist in stable equilibrium under the influence of the mutual attractions of the molecules. On the *dynamical* theory of crystal structure hardly any work has yet been done, but the *geometrical* theory is now fairly complete.

GRESHAM COLLEGE LECTURES.—A course of lectures on "Recent Solar Researches" was delivered at Gresham College during Whitsun week by Mr. E. Walter Maunder, F.R.A.S. The subjects of the lectures, delivered on successive evenings, were "Changes and Movements of Sunspots," "The Structure of Sunspots," "The Solar Atmosphere," and "Solar Periods and Influence."

Aeroplane Experiments at the Crystal Palace.

By Major BADEN-POWELL.

IT has often been supposed that one of the greatest difficulties to be overcome before successful aerial navigation can be achieved is the practical balance of the apparatus in mid air. Whether or not this will really prove a stumbling block it is impossible, with our present experience, to state with certainty. Several inventors, it is true, have had considerable difficulties in the initial starting of their machines, which have had a way of toppling over as soon as they have been launched into the air. It seems just possible, however, that if the machine could



Starting.

be properly trimmed before starting, all such difficulties might be overcome. We know that small models, if dropped from the hand or lightly thrown forward, will easily upset, if not properly balanced, but which, if the weights be carefully adjusted beforehand, will fly steadily enough on their downward course. But it is extremely difficult to calculate the position of the centres of gravity and of pressure, and practical trial is the only certain method of getting this balance. How, then, is it possible to test practically the balance of a machine which we are loth to launch into mid air because we are afraid of its toppling over?

With a parachute or surface dropping perpendicularly, the weight should, of course, be in the centre of area; but if a more or less flat surface be progressing through the air horizontally, it is found that the centre of pressure advances towards the front edge, and, therefore, if the weight be in the centre, the plane will rapidly rise in front, and will soon overbalance and shoot down backwards. But the more rapidly the machine is travelling, the more does the

centre of effort advance. It would, therefore, seem to be necessary to shift the balance in accordance with the speed. The angle presented by the aeroplane also causes this point to vary, so that experiments with the tilting of the aeroplanes are also necessary.

It is often supposed that, in addition to what we may call the "passive" or "fixed" balance, we must take into account the action of the air currents on the wings. These may be the result both of the eddies caused by the progression of the planes through still air and of gusts of wind blowing against them.

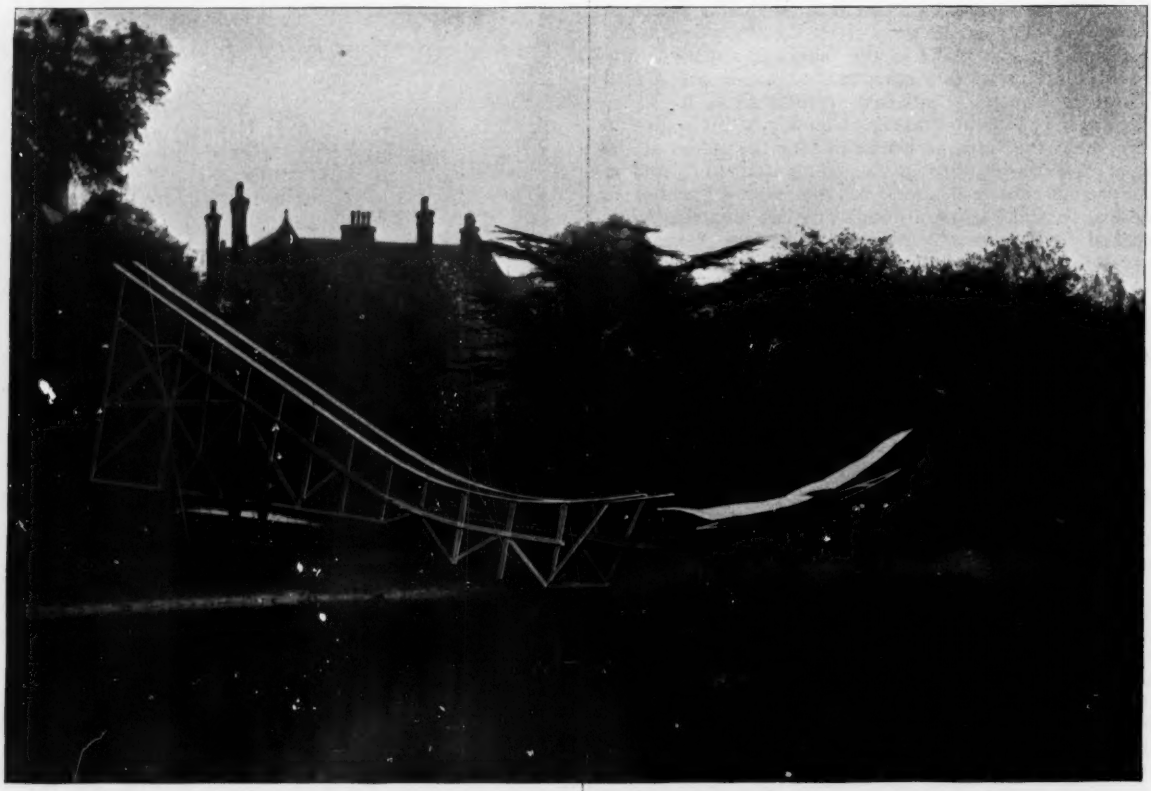
These actions and re-actions are little understood. Some authorities think that a large flying machine will be blown about like a piece of paper in the breeze, while others declare that a heavy machine progressing at a speed far greater than that of the wind will scarcely be affected by it.

Another problem calling for practical solution is that of steering. Vertical and horizontal rudders may seem a simple expedient, but it is doubtful if they form the most efficient means of steering. A bird has no vertical rudder, and tests with large gliding machines have proved them to be not entirely satisfactory.

It is therefore manifest that before we can build a proper airship we must make a series of trials with some apparatus progressing through the air and carrying an aeronaut to direct its course. Several experimenters have tried gliding machines, which have been designed either to soar down the face of a hill in the teeth of a wind, or to be drawn along by a string. But in addition to other drawbacks, these systems have the serious objection of being very dangerous to the operator. Already two of the principal experimenters in this line have unfortunately lost their lives through some small deficiency in their apparatus, and if tried over land there is always the danger that any small mishap may result in the machine losing its balance and precipitating its operator to the ground. Such machines, at all events as hitherto designed, cannot well be tried over water for several obvious reasons.

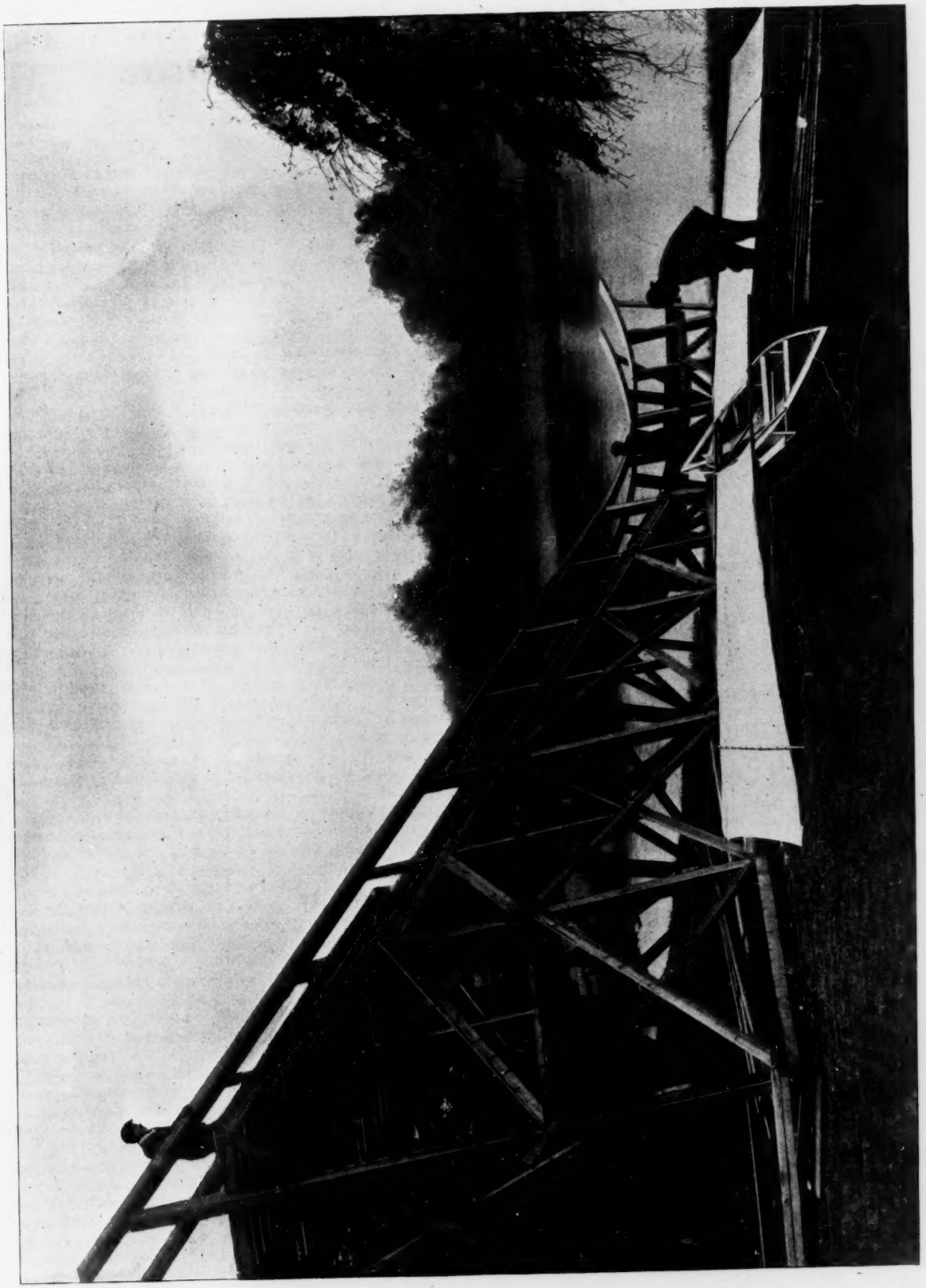
Moreover, such apparatus would usually progress comparatively slowly. Now, to support itself in the air an aeroplane must move along at a very considerable speed, and the questions of balance and of steering are undoubtedly much dependent on the rate of progress.

One of the simplest means of giving an initial speed to any body is to cause it to run down an inclined track and to shoot off into the air at the bottom. If means are adopted to prevent the machine from leaving the track before it gets to the bottom, and if it is then projected over a sheet of water, there can be but little chance of a serious accident.



Aeroplane leaving the Track.

I therefore decided, some months ago, to erect such a track, and conduct a series of experiments. Existing "water-chutes" at once suggested themselves as ready-made tracks, but, after examining several, and even making experiments with aeroplanes on them, I came to the conclusion that such were not suitable to the purpose. They are not steep enough to get up sufficient speed, they are not sufficiently turned up at the bottom to shoot the apparatus off in a horizontal direction, and rails and lamp-posts interfere with large wings. Besides, it would be difficult to arrange any method by which the aeroplane could be prevented from rising off the track before



Aeroplane and "Chute."

arriving at the bottom, which it is very apt to do in gusty weather.

By the courtesy of the Management of the Crystal Palace, the magnificent grounds of that institution have been placed at my disposal, and a most suitable spot was soon found beside the Intermediate Lake. Here I have had a large staging erected, of which the accompanying photographs will give a good idea.

Mr. C. J. Blomfield, the well-known architect, very kindly undertook to superintend the details of construction. This staging is of wood, the upper end being some 30 feet above the level of the lake. The incline is one in two, the lower end forming a curve of 60 feet radius. The "take off" is on an upward incline of one in ten, the lowest portion of the track being about ten feet from the outer end, which is six feet above the water level.

The rails are composed of solid slabs of oak securely bolted to the structure, and projected inwards so as to allow of runners engaging on their under sides as well as on the upper. They have a gauge of 2 ft. 6 in. These are carefully smoothed and greased to minimise friction. The flying apparatus consists of a boat, flat-bottomed, and with a considerably rockered stem, about 20 feet long over all, by 2 ft. 6 in. beam. From the sides of this project runners of oak to slide on the rails, and also some projections which are to engage the under sides of the rails in the event of the wind lifting the wings on one side, and thus prevent the machine being overturned or lifted upwards off the track.

The rate of descent is found to be 50 feet per second near the bottom, but this speed is, of course, diminished slightly during the upward incline before the boat leaves the track. An electric chronograph is to be fitted so that the speed can be measured over various sections of the track. The track is only just completed, and the proper man-carrying boat is still in hand.

The photographs show a skeleton pattern boat which was constructed to better get at the most suitable dimensions and shape. This, as may be seen, was fitted with two rectangular aeroplanes, each 12 feet by 5 ft. 6 ins., so that the area of this model is 132 square feet. Later on it is proposed to apply other shapes and forms of aeroplane to compare various patterns, and tails of different designs will also be tried.

I propose shortly to start making regular trials and shall hope to be able to give full accounts of these in the next number of "KNOWLEDGE & SCIENTIFIC NEWS."

Mr. J. Semenoy (see *Journal de Physique*, Feb., 1904) causes electric sparks to jump between two gas flames or a flame and a metallic electrode, or else between two metallic electrodes separated by a small gas flame. By this arrangement the glow is eliminated, so as to enable the spark proper to be examined separately. In fact the metallic vapours constituting the glow are blown away by the gas stream of the flame. The image of the spark is projected by means of a convergent lense on the vertical slit of a direct-vision spectroscope, the axis of which is perpendicular to the plane of the spark gap.

Semenov's experiments go to show that *electric currents in gases* are a *molecular phenomenon;* this would be in accord with Professor Bouty's researches on the dielectric cohesion of gases, which is also a *molecular* property.

Such currents are attended by the dissociation and projection of matter, the paths of which are in each point of the spark orientated in a plane perpendicular to the line of current. On account of the projection of matter taking place round the spark, a vacuum must be produced along the spark, the atmospheric pressure throwing into this vacuum the air and metallic vapour surrounding the electrode; this is obviously one of the causes of the transport of matter taking place from one pole to the other.—A. G.

The Development of Parasitism.

By J. REYNOLDS GREEN, Sc.D., F.R.S.

THE early ancestors of all plants now existing are generally held to have been aquatic organisms of fairly simple type, and of not very complex structure. Without going back to the extremely simple protoplasmic entity, whose nature cannot be said with certainty to have been vegetable rather than animal, we must admit the existence of a race of plants, each of which was capable of living for and by itself, of carrying on all the functions of nutrition, and of reproducing itself. The power of nourishing itself involved a further power; it must have been able, under the influence of the rays of the sun, to construct organic food material from the inorganic simple compounds furnished to it by its environment. The possession of this power was one of the earliest acquired marks of distinction between the animal and vegetable organisms, for though traces of it may be found in the former, they are but traces; and it is uncertain how far they actually pertain to the animal world. The vegetable organisms on the other hand, having once acquired the power, have retained and developed it till it is now recognised as their special and distinctive feature.

This peculiar property of constructing organic material from inorganic, on which all physical life depends, is associated with the presence in the vegetable organism of a peculiar green colouring matter, known as chlorophyll. The pigment is in nearly all cases found associated with peculiar differentiated portions of the living substance, known as plastids, which, though commonly small ovoid bodies lying in the general protoplasm of the organisms, may in the more lowly forms assume curious shapes. The power of food construction from inorganic materials and the presence of these *chloroplastids* go together, and the possession of what is often called this *chlorophyll apparatus* is the distinguishing feature of most plants.

Endowed with this apparatus, exposed to the rays of the sun, supplied with such simple inorganic substances as the carbon dioxide of the air, the water and the nitrates, sulphates, and phosphates of the soil, the plant can fight its own battles and reproduce its race.

In studying the vast field of vegetation that the face of the earth presents us with, however, we come across many types which are not nourished in this way, which have no power of food-construction, and which can only live, animal fashion, on organic materials ready made for them.

Looking more closely into the habits of such plants, we can distinguish between two classes of them, one thriving on dead, decaying organic matter, the other preying upon living organisms.

The latter form the great group of parasites, a degraded class which thrives by robbing other organisms of the food they have acquired, and by taking from them their own vital fluids, causing malnutrition and death.

The study of parasitism as seen in the vegetable kingdom illustrates very fully the law which is so well illustrated in the processes of the evolution of the races of both animals and plants, that disuse is followed by atrophy. Whether the parasitic plant lives at the expense of another plant or whether it attacks an animal or ganism, the result is the same—the disappearance of its

chlorophyll apparatus, the loss of the power of food-construction, and a consequent degradation of structure, always found accompanying such impotence.

The development of the parasitic habit has not taken place among one group of plants alone, and the parasitic plants are not therefore connected with one another by any ties of descent or inheritance. Parasitism has been acquired by simple and by complex plants, and apparently more than one chain of circumstances has led up to it.

Among the simpler families we find the great class of bacteria, or germs, in many cases parasitic, though others live on dead organic matter. Such as the latter are designated *saprophytes*, and in many cases they mark a halfway house to parasitism. A group of somewhat higher type is afforded by the fungi or moulds, which, like the former, include both saprophytic and parasitic forms.

From their structure these parasitic fungi are closely allied to the filamentous algæ or sea-weeds, from which it is clear that they have been derived. There are many families of these aquatic organisms, distinguished from each other by their peculiar methods of reproduction. There are corresponding groups of fungi, and from comparison of them there can be little doubt that the fungi have been developed from the algæ which they resemble.

The process of their development, though based upon existing forms of both, can be fairly satisfactorily traced. We have, however, only *probability* to point to, for we have not very satisfactory transitional forms. The main difference between the two is the presence of the chlorophyll apparatus in the one and its absence from the other. This involves, however, a change of habit of life which has led to modification of the structure of the plant body.

It is not very difficult to see how the parasitic habit probably arose in these lowly plants. Their bodies are not differentiated into definite members like the higher plants, but are little microscopic spheres or flat plates, or filaments. Many of them now are found to be living in a sort of association with each other, not helping each other further than by supplying mechanical support. If we imagine a comparatively large form supporting a number of smaller ones, we can see that its death and decay would present to those adhering to it a considerable amount of organic material ready for consumption. Such a source of food supply may well have been utilised, for its absorption would relieve the adhering plants from much labour of construction. A saprophytic habit thus assumed would be likely to be permanent, and the manufacture of the now unnecessary chlorophyll apparatus would gradually die out.

The forms thus acquiring saprophytism have been many and varied in their form. The great majority have been filamentous, consisting of long threads known as *hyphæ*. These threads permeate the mass of the decaying organic matter. Such are many of our common moulds, which are developed now so easily upon syruppy substances.

The passage from this comparatively harmless way of getting food to the destructive form of parasitism is not very difficult. We can trace it in many of the fungi which are at our side to-day. Instead of waiting for the death of the plant to which the fungus is attached, the latter in many cases kills it by secreting and pouring out a toxic substance or poison which causes a local death of the tissue with which it comes into contact. Into this dead nidus the filaments of the intruder then grow, and so its establishment takes place in the interior of its host, such growth being preceded by a destruction of the latter, the materials so formed being the food of the fungus. This conduct marks a stage very near to the establishment of the true parasitism, which involves only the feeding of the intruder on the materials of the host plant, prior to death and decomposition. This change of nutritive method soon follows, the intruder gaining the power to assimilate the juices of its host without any such decomposition. Then the gradual weakening of the host is the sign of the invader, which has ceased to manufacture the toxin or poison which was at one period a necessary phase in the process of the nutrition.

We cannot point to organisms which are at present in the early stages of this transformation of nutritive processes, but certain fungi can be found which have hardly passed beyond that of the loss of the chlorophyll apparatus. One which is known as *Pythium* attacks young lettuce seedlings, causing the disease known as *damping off*. This illustrates the change; it has no green colour, and gains all its food from the living tissue of the seedlings, but its structure, and especially its modes of reproduction, are strikingly like those of the algæ to which it is related. The reproductive cells which it forms, their shape, and structure, the mode of their formation, and their general behaviour are strikingly algal. Among the various species of the genus we find forms which are gradually losing these algal peculiarities, and are beginning to show the degradation of structure which always is associated sooner or later with the parasitic mode of life.

Besides these pathogenic forms, bacterial and fungal, associated emphatically with a diseased condition of the host plant, Nature shows us others which are much higher in the scale of organisation, belonging indeed to the highly organised flowering plants. When we pass in review a series of these parasites we find the same succession of events, the acquirement of parasitism accompanied by a loss of the power of constructing organic substance and a progressive degradation of the whole organism.

In tracing the development of the habit among these higher plants we find suggestions that it originated in a different way from that which we have noticed among the fungi. Saprophytism is not unknown among the flowering plants, but it has apparently had no part in the development of parasitism. The origin of the latter must be looked for in the close relationship often found existing among plants which were originally nothing more than neighbours, by virtue of which they came to help one another in a peculiar manner in the struggle for existence. This relationship, known as *symbiosis*, is a union of two plants for their mutual benefit. It is seen in many cases, conspicuous among which we have the *lichens*, peculiar organisms consisting of an alga and a fungus living in close relationship with each other, each contributing a share to the well-being of the compound organism.

The origin of such symbiosis among the higher plants can be seen in the case of a group of plants often known as *rootparasites*. They include many members of the Natural Order *Scrophularinæ*, e.g., the yellow-rattle which grow in pastures and waste ground. The roots of these plants are growing freely among the roots of the other plants, the grasses, &c., of the pasture. Coming into contact with these, the irritation of the contact causes a swelling to arise upon the root of the rattle, and from this growth delicate filaments emerge which penetrate the grass root and set up an intimate relationship between the two, which become so far united that liquid matter can pass with comparative ease from the one to the other. The relationship so set up is not particularly harmful to the grass; indeed, it seems to be beneficial to both symbionts, bringing about in a way an equalisation of the nutritive material that both are engaged in making. It involves

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no diminution of the chlorophyll of either, and no degradation of structure.

A further stage in the acquirement of the parasitic rather than the symbiotic habit is exhibited by the mistletoe and its allies. We are most of us familiar with the mistletoe, an evergreen plant with pale greyish-green leaves, found growing on the poplar, apple, &c. It arises in all cases from the germination of seeds deposited by buds in the bark of the branches of the host. The young rootlet of the mistletoe inserts itself into the bark, and penetrates the soft tissues of the cortex as far as the young wood. Subsequent growth and development, which are accompanied by the co-incident growth and increased thickness of the branch, lead to the establishment of a very close union between the tissues of the two, and as the plumule of the seed develops and the upper portion of the mistletoe plant increases, the two are so firmly joined that the organic food of the host is easily absorbed by the intruder. The relationship is still symbiotic, for while during the greater part of the year the host plant feeds the mistletoe in preponderating measure, in the winter, after the leaf-fall of the host, the evergreen guest contributes to the nutrition of both. The plant shows, however, the beginning of the inequality of symbiotic effort which is the antecedent of parasitism. Co-incident with this we find the beginning of the degradation of the chlorophyll apparatus, the mistletoe possessing leaves of very grey-green colour.

The inequality thus established can be traced a stage further in the genus *Orobanche*, the so-called *broom-rapes*, which are far from uncommon among our wild plants. They consist of a large fleshy stem ending in a spike of flowers; the stem bears a few almost rudimentary leaves which are almost brown, having but little green matter in them. The broom-rape is found seated upon the roots of some other herbaceous plant, and is furnished with a greatly thickened and swollen base by which the attachment is made. The swelling is due to the absorption of nutritive matter from the host plant, which is now almost the only source of food possessed by the intruder. Parasitism is practically established; the chlorophyll apparatus of the broom-rape is rudimentary and abortive, and the burden of feeding both falls upon the host plant which suffers in consequence.

The common Dodder shows as yet another stage. The plant infests many herbaceous plants, especially clover. The seed germinates on the ground, and the young embryo twines itself around some neighbouring stem. Having established its hold, it forsakes the ground, and in all its subsequent growth it twines more and more fully round its host. The long twining stem bears no leaves, and contains no chlorophyll. At intervals along its course it puts out sucking root-like filaments, which perforate the host and set up a close union between the tissues of the two. So fed, the Dodder flowers and seeds, altogether at the expense of its host.

Our own flora shows us no more complete instance of a parasite than this. In some tropical areas a parasite can be met with which lives entirely wrapped up inside the tissues of its host. The degradation of its structure is complete, for its anatomical complexity is reduced to a very close resemblance to the hyphal network of a fungus. Here and there an outgrowth of the plant penetrates the surface of the host plant, and develops into a flower, which in some cases has an enormous fleshy body. The parasitic habit now dominates the plant; it lives only to produce its flower, it has lost all trace of normal structure, it obtains everything from the internal tissues of its host, and stands before us indolent, atrophied, and yet triumphant.

The Autobiography of Herbert Spencer.

THE late Mr. Herbert Spencer has written his "Autobiography" (Williams and Norgate) in a vein of exceeding seriousness. Other men who have written their autobiographies endear themselves to their readers by their unconscious revelation of character, even their human weaknesses. Mr. Herbert Spencer had no human weaknesses; he appears in his autobiography as the personification of abstract thought. It is true that he was a dutiful son; indeed, in speaking of his mother, he approaches more nearly to tenderness than on any other occasion, but even here he displays that detached clear-sightedness that characterises all his relations in life. "Of my mother's intellect there is nothing special to be remarked," he comments, and adds with that one touch of feeling already mentioned, "speaking broadly, the world may be divided into those who deserve little and get much, and those who deserve much and get little. My mother belonged to the latter class; and it is a source of unceasing regret with me that I did not do more to prevent her inclusion in this class." The reader is feign to share her son's retrospective sympathy for Mrs. Spencer when he learns something of her husband's irritating characteristics. "He held, for instance, that everyone should speak clearly, and that those who did not ought to suffer the resulting evil. Hence, if he did not understand some question my mother put, he would remain silent; not asking what the question was, and letting it go unanswered. He continued this habit all through life, notwithstanding its futility." Mr. Spencer arraigns his earlier Huguenot and Wesleyan progenitors in the same scientific spirit, tracing in his own character kindred traits derived from them. "That the spirit of Nonconformity is shown by me in various directions, no one can deny," he says in conclusion. "The disregard of authority, political, religious, or social, is very conspicuous. Along with this there goes, in a transfigured form, a placing of principles having superhuman origins above rules having human origins, for throughout all writings of mine relating to the affairs of men, it is contended that ethical injunctions stand above legal injunctions."

The elder Mr. Spencer postponed his son's education on grounds of health; but, desultory as it was, at thirteen he had acquired considerably more general knowledge than is common at that age. Of Latin and Greek, he knew "nothing worth mentioning." Of English grammar or history, he was entirely ignorant, and the deficiency in his literary education makes itself felt in the roughness of his English; but, on the other hand, "my conceptions of physical principles and properties had considerable clearness, and I had a fair acquaintance with sundry special phenomena in physics and chemistry." A far more important mental acquisition, and one in which school education is conspicuously deficient, was what Mr. Spencer describes as the habit "of intellectual self-help," which his father was continually inculcating. Shortly after he was thirteen Herbert Spencer went to continue his education at the house of an uncle, where he seems to have derived more benefit from mental and moral discipline than the actual acquisition of knowledge. Soon after his return home he entered on a brief career as a teacher, his father's profession. In 1857 he obtained a post under Mr. Charles Fox, Permanent Resident Engineer of the London division of the London and Birmingham Railway during its process of construction.

"I arrived in London on the 8th November, 1837. . . . The Queen, who had but lately succeeded to the throne, and was not yet crowned, dined with the Lord Mayor in the City on the 9th of November, and the occasion called for a State Pageant. It was the only Royal procession or display of allied kind which I ever saw." He adds later: "I was quite alive to the responsibilities of my post and resolute to succeed. During

the whole of my sojourn in London, lasting over six months, I never went to a place of amusement; nor ever read a novel or other work of light literature." It was surely this incapacity for healthy recreation, ingrained by his education, that was largely responsible for the ill-health and nervous strain with which Herbert Spencer had to contend during his later years. One cannot read without a smile his grave animadversions on the companions with whom he was thrown at the engineering offices at Worcester, to which he subsequently went. "Unlike the pupils of Mr. Charles Fox, quiet youths, carefully brought up (two of them being sons of dissenting ministers), the junior members of the Birmingham and Gloucester staff belonged largely to the ruling classes, and had corresponding notions and habits." . . . "The superintendence was not rigid, and the making of designs was interpersed now with stories not of an improving kind, now with glances down on the passers by, especially the females, and resulting remarks; there being also a continuous accompaniment of whistling and singing, chiefly of sentimental ballads." Among these young men Herbert Spencer was, however, able to form one congenial intimacy, which we remark upon because it instances again that detached quality of mind already mentioned, that habit of appraising his fellows, even his most intimate friends. "He was the son of Dr. Jackson, at that time Foreign Secretary to the Bible Society. Of somewhat ungainly build, and with an intellect mechanically receptive, but without much thinking power, my friend was extremely conscientious." . . . "Association with a man whose intellectual powers were above my own would have been more advantageous," he adds.

About this period, Herbert Spencer notes that religious beliefs were slowly losing their hold, "the creed of Christendom being evidently alien to my nature, both emotional and intellectual." "Criticism," he continues, "had not yet shown me how astonishing is the supposition that the Cause from which have arisen thirty millions of Suns, with their attendant planets, took the form of a man, and made a bargain with Abraham to give him territory in return for Allegiance." "I had not at that time," he continues, "repudiated the notion of a deity who is pleased with the singing of his praises, and angry with the infinitesimal beings he has made when they fail to tell him perpetually of his greatness," an extraordinary crudeness of statement "of the Creed of Christendom," which can only be accounted for by Herbert Spencer's Nonconformist antecedents.

In 1841, Herbert Spencer returned home, partly to pursue a course of mathematical study, and partly to carry out his father's idea of an electro-magnetic engine. Neither scheme was pursued. It is curious to find him continually commenting on his "constitutional idleness," which "has taken the form of inability to persevere in labour which has not an object at once large and distinct." The years that followed, though they were apparently desultory and futile from the point of view of material advancement, were of crucial importance in the history of Spencer's subsequent career, and in determining the bent of his genius. He instances, as a step in his mental development, the letters on social questions contributed by him to the *Nonconformist*, an organ of the Advanced Dissenters, letters which originated in political discussions with an uncle, who introduced him to the editor:—

> "Had they never been written, Social Statics, which originated from them, would not even have been thought of. Had there been no Social Statics, those lines of enquiry which led to 'The Principles of Psychology' would have remained unexplored. And without that study of life in general, initiated by the writing of these works, leading presently to the study of the relations between its phenomena and those of the inorganic world, there would have been no System of Synthetic Philosophy."

Meanwhile, he was besides variously occupied journalistically and otherwise, and in 1850 appeared his first book, "Social Statics; or the Conditions Essential to Human Happiness Specified." "Assuming happiness as the end to be achieved, it regarded achievement of it as dependent on fulfilment of conditions, conformity to which constitutes morality."

After the appearance in 1855 of his second book "The Principles of Psychology," he suffered from a serious breakdown in health which enforced a long period of idleness. To these two books Mr. Spencer appends with characteristic aloofness of mind two hypothetical reviews, criticising his own arguments and summarising his doctrines. As soon as his health was sufficiently recovered, he set to work upon his "System of Synthetic Philosophy." He describes himself at this time as "a nervous invalid" "having only precarious resources," and his undertaking, so monumental a task, necessitated a heroic struggle with physical weakness. After the publication of the first early part of the work he found himself obliged to decide upon the abandonment of his design. His parents were in need of his support, and he had already trenched considerably upon his small capital. The proposal immediately called forth the following generous response from J. S. Mill:—

"It is right that you should be indemnified by the readers and purchasers of the series for the loss you have incurred by it. I should be glad to contribute my part, and should like to know at how much you estimate the loss, and whether you will allow me to speak of it to friends and obtain subscriptions for the remainder."

The proposal was eventually declined. The death of the elder Spencer lessened his son's responsibilities, and American admirers placed 7000 dollars to his credit in public securities. Of Herbert Spencer's relations with his contemporaries we have hardly space to speak. One instance must suffice of the shrewd but merciless clear-sightedness with which he estimated the mental and moral calibre of his acquaintances. Of Carlyle he says: "He has, strange to say, been classed as a philosopher! Considering that he either could not or would not think coherently—never set out from premises and reasoned his way to conclusions, but habitually dealt in intuitions and dogmatic assertions, he lacked the trait which, perhaps more than any other, distinguishes the philosopher properly so called. He lacked also a further trait. Instead of thinking calmly, as the philosopher above all others does, he thought in a passion. It would take much seeking to find one whose intellect was perturbed by emotion in the same degree."

Photography.

Pure and Applied.

By CHAPMAN JONES, F.I.C., F.C.S.

IN introducing the first of the Photographic sections to the readers of "KNOWLEDGE," it is fit that I should say something as to the general character of the matter that they may expect to find in this part of the journal. Everyone may now be considered to take a practical interest in photography, just as everyone knows how to write his own language intelligibly. Therefore it will be my endeavour to deal with matters connected with the practice of the art as opportunity seems suitable. A few perhaps take an interest in photography for its own sake; and as the pure science of to-day may be regarded as the applied science of to-morrow, I shall hope to draw the attention of readers to notable items of progress in photography, even though their immediate application may not be very obvious. But in all cases it will be my endeavour as far as possible to meet the needs of all who take the trouble to read these notes, and to enable me to do this I shall welcome any suggestions or questions of general interest, and the account of any photographic experiences, whether in connection with scientific work or the general practice of the art.

The Rendering of Colour.—It is a notable sign of the times that the only films now made by the Kodak Company are colour sensitised or isochromatic. Although

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colour-sensitised plates have been available for many years, and in photo-micrography and other scientific work they have long been considered as indispensable, even those who know the advantages that they offer too often appear to lose their critical sense as soon as they take their cameras out of doors. It is a mistake to suppose that the proper rendering of variously-coloured objects is an artistic matter; it belongs to the realm of science, and the reason that it is neglected is that we have got so used to the conventional errors in the representation of coloured objects in monochrome by photography that they do not offend the eye as errors in outline do. Another reason is, I think, that it has so often been represented of some colour-sensitised plates that they do not need a coloured screen, that many who have seen the results of their use without that assistance have been unable to find any advantage in them. There is no available colour-sensitised plate that will give an advantage worth having in ordinary work by daylight, even if detectable by critical examination, unless it is used in conjunction with a coloured screen. The sensitiveness to blue light is so overpoweringly great that the little added sensitiveness to green, yellow, or red is lost unless the blue light is reduced. And the deeper the colour of the screen the more correct will the resulting photograph be so far as the use of well-known commercial screens (or light filters as some call them) is concerned. By the injudicious use of dyes it is easily possible to absorb so much blue that this colour photographs as if it were black, while yellow and green will appear as if white. It is safest not to use a screen that requires the exposure increasing to more than about eight times, unless one has some guarantee that it is suitable. At about this stage, and beyond it, it becomes necessary to adjust the screen to the particular plate that is to be used. It is a mistake to suppose that a coloured screen renders exposures outrageously long. The screen that probably requires a greater increase of exposure than any other on the market, the "Absolutus" screen made by Messrs. Sanger Shepherd, and Co. to suit Cadett's spectrum plates, and it requires exposures out of doors to be increased about forty times, as a rule only needs the giving of a few seconds' exposure instead of a fraction of a second. For hand-camera work, it is well to have a screen that needs the exposure to be doubled, and also one that requires it to be increased to four times or more for use when circumstances permit. It is well worth the little extra trouble involved if only for the sake of the improvement that will be manifest in the skies, especially when these are partly or wholly cloudless.

Catatype.—This interesting process seems to be still in the doubtful stage so far as its practical uses are concerned. It was patented nearly three years ago by Messrs. Ostwald and Gros, and is one of the results of Professor Ostwald's investigations in connection with catalysis. Finely divided metallic platinum or silver causes the decomposition of hydrogen peroxide when merely brought into contact with it. If, therefore, a photograph in which the image consists of metallic silver or platinum is flooded with a solution of peroxide of hydrogen in ether, when the ether has evaporated the peroxide will be decomposed where it is in contact with the finely divided metal, and if the original is a negative there will be on it an invisible positive image in hydrogen peroxide. By pressing such a treated photograph against a gelatine film for about thirty seconds, a notable quantity of the peroxide will be absorbed by the gelatine, and such a "print" can be developed, or made to give a visible result in many ways. An alkaline silver solution will give a black image of metallic silver, an alkaline lead solution a brown image of lead peroxide, and so on. By treating such a print with a ferrous salt, the peroxide will convert the ferrous salt into a ferric salt and this will render the gelatine insoluble in water. If the gelatine has been mixed with a pigment, as in ordinary carbon tissue, and the print is developed by means of warm water as an ordinary carbon print is developed, it is stated that this method of producing carbon prints gives the print ready for development in about two minutes instead of the time usually required to sensitise the tissue with bichromate, dry it, and expose it behind the negative. The process may also be available for photo-mechanical work, for it is stated that gelatine that has absorbed peroxide of hydrogen will take up a fatty ink after the manner of chromated gelatine that has been exposed to light. It is to be hoped that we shall soon hear more of the practical applications of these methods.

(*To be continued.*)

The Antiquity of the Constellations.

TO THE EDITORS OF "KNOWLEDGE."

GENTLEMEN,—Let us hope that Mr. Maunder may tell us more about the origin of the constellations. The late Mr. Proctor was very bold and fixed the date at which they were invented (or revealed) at 2170 B.C., neither more nor less. Mr. Robert Brown, too, one would gather, was given (like Balbus) to rashness in speculation.

Mr. Maunder puts the approximate date at 2800 B.C. But some difficulties suggest themselves on the brief summary of his arguments, *e.g.*:—

(1) The centre of the space not included in the ancient constellations must have been the S. pole of the period when they were designed.

But do we know all the ancient constellations? A recent work, "Sphaera" (referred to below), gives, not 48, but some 150. Many are duplicates (and the variants are curious and interesting). Others are quite unidentified, *e.g.*, the market place, the two skulls, the stag with two snakes in his nostrils.

(2) The tradition of the four royal stars marking the colures.

But Regulus was a "royal" star for an obvious astrological reason. It was the heart of the royal beast, the lion, and was supposed to rule the fates of kings. (The star called Cor Hydrae, or the serpent's heart, denotes trouble through women.) If the Persians called other stars "royal" they may have had equally good (or bad) reasons of the kind.

(3) The date gives the only symmetrical position for the actual constellations of the Zodiac.

But there is a strong tradition that they were originally eleven, not twelve, and their position otherwise is far from symmetrical.

(4) The ascending signs at this date faced east; the descending west.

But why did three face nowhere in particular? Manilius gives amusing explanations.

(5) There are traditions of Taurus leading the Zodiac.

Possibly, but the familiar lines of Vergil in the first Georgic do not prove this.

It is not safe to base arguments on poetry, and, in fact, Seneca finds fault with the agriculture of this very passage (Ep. 86): "Our Virgil considered effect more than truth and wished to please his readers, not to teach farming." But the astronomy is right enough. Virgil is thinking of April, and Ovid's lines (Fast IV. 88) are the best explanation:—

Nam, quia ver *aperit* tunc omnia, densaque cedit
Frigoris asperitas, fetaque terra patet;
Aprilem memorant ab aperto tempore dictum.

or

When that Aprillë with his showrës soote
The drought of March had perced to the roote.

According to Columella the sun enters Taurus on April 17, and the dog sets with the sun on the last day of the month.

My principal object in writing this letter is to call attention to the German book ("Sphaera," by Franz Boll, Leipzig; Teubner. 1903) above referred to, which gives new Greek texts, and sheds a flood of light on the history of the constellation signs.

The new texts are astrological, and indicate a promising field of investigation.

One vexed problem which is incidentally solved is that of the so-called Zodiacs of Dendera, which, though neither Zodiacs nor pictures of the heavens at any date, are shown to be of capital importance in a new direction.

I am, Gentlemen,
Your obedient Servant,
T. K. ARNOLD.

23, West Side, Wimbledon,
Feb. 18, 1904.

[Mr. Arnold has not quite understood the significance of Dr. Franz Boll's valuable work. The new Greek texts discovered and discussed by him have no direct bearing on the origin and antiquity of the constellations. They were found in late mediæval manuscripts and consisted of excerpts from astrological writers of the first to the fifth centuries of our era. The chief interest attaches to the discovery of some texts of the writings of the Babylonian astrologer Teucros; perhaps better known to English readers as Zeuchrus, who lived about the Christian era or in the first century A.D. Mr. Arnold has apparently been misled by Dr. Boll's use of the word "sternbilder." The additional constellations of which Mr. Arnold speaks are mostly not "constellations" at all in the sense in which we ordinarily use that word, *i.e.*, groups of actual stars, but are simply decanal symbols. The "decans," or portions of the ecliptic ten degrees in length—three therefore to each sign of the Zodiac—go back to a great antiquity, but are necessarily of much later date than the original mapping out of the constellations. For the actual constellations are most irregular in length, and the division into decans implies that the ecliptic had been previously divided into twelve equal parts, bearing only a rough relationship to the constellations and not corresponding to the actual stars, though the new "Signs" naturally took their names from the old "Constellations." The symbols attached to the 36 decans are therefore not truly stellar at all; they partly look back to the Egyptian system of placing the year under the protection of 36 deities, partly to the association of each of the twelve zodiacal constellations with its "paranatellonta" or extra-zodiacal constellations, and partly to the desire of the astrologers to have a fuller supply of prognostics to work with than the twelve signs alone could give. Thus the "Agora," or Market Place, mentioned by Mr. Arnold, was in the second decan of Libra; and was clearly but an enlargement of the idea suggested by the Balances, of buying, selling, and weighing. It is not a question of an actual star group bearing that name. It simply indicated the middle ten degrees of longitude of the "Sign" Libra. The "two skulls" are neither new nor unidentified. Dr. Boll himself points out that they are mentioned by Albumasar, one of the best known of mediæval astrologers of the Ninth Century A.D. They are placed, usually with other symbols, in the third decan of Libra, and quite possibly are nothing but a very corrupt form of the "Heavenly Twins," Adonis and Aphrodite, Tammuz and Istar, *i.e.*, the Sun and Moon. There is no reason for surprise that so much variation is found in the symbols attached to the decans and their sub-divisions. They never had the authority, for they had not the antiquity, of the constellations, and many, no doubt, owed their origin to the caprice of individual astrologers, or to an imperfect understanding of symbols employed in foreign systems. Dr. Boll's work supplies some interesting cases of the wide differences shown in manuscripts professedly based upon the same original authority.

As to another point raised by Mr. Arnold, the constellations of the Zodiac, so far as we can trace them with certainty, were always accounted twelve, even if only eleven separate figures were shown. The Scorpion had a double portion allotted to him in schemes which did not display the Balance; sometimes, as in the Greek scheme, his claws extended to the feet of Virgo; sometimes a second scorpion took the place now held by the Balance. But it will be noted that Libra is recognised by the astrological scheme; so that whenever the Balance was introduced it must have been before the working out of systematic astrology, and before the division of the "signs" into "decans."

Mr. Arnold's explanation of the name of Regulus does not lead us far. It leaves unexplained why a lion was designed in that part of the sky. But if Regulus got its name of "King" when it marked actually the highest point of the ecliptic, on account of its pre-eminent position, it would not be very unnatural that the form of the "King of Beasts" should be figured out round it. The Southern Fish and the Scorpion are certainly not "royal" beasts at all; the Bull questionably one; so that no astrological reason is likely to have gained that title for Fomalhaut, Antares, and Aldebaran. But their relation to the other colures being so similar to that which Regulus held to the colure of the summer solstice may well have caused the title to be extended to them; especially as the date indicated agrees so well with that suggested by the unmapped space in the south.

The three signs which face nowhere in particular are Libra, which had no face to turn, and Pisces and Gemini, which had each two, looking in opposite directions. Doubtless the ancients had some special reasons for making the Fishes swim away from each other, and the Twins face each other, but I fear it would be only guess-work to suggest them now. It is clear that the nine remaining signs, which have all one face apiece, are arranged as I state.

Is not Mr. Arnold a little inconsistent in saying that "it is not safe to base arguments on poetry" and then immediately proceeding to adopt the method he condemns? And how does he know that Vergil was thinking of April? The real significance of the familiar quotation from the Georgics lies in the fact that not only did the Ram actually "open the year" in Virgil's time, but that it was generally recognised as doing so. The quotations from Ovid and Columella are as little relevant to the question before us as the one from Chaucer.

Dr. Boll's examination of the planisphere of Denderah is sufficient to show, what has long been recognised, that that monument can throw no light upon the antiquity of the constellations.—E. WALTER MAUNDER.]

The Mechanical State of the Sun.

By Professor R. A. SAMPSON, F.R.S.

A GLANCE backwards at the theories which have attempted to give a reasoned and connected view of current knowledge of the Sun suggests that knowledge and theory are complementary, so much more detailed and precise was theory when little or nothing was known. It was from little more than the darkness of the sunspots, with Wilson's theory that they were depressions in the photosphere, that Sir William Herschel elaborated his doctrine of a Sun with inhabitants and luxuriant vegetation;* and if it is now clear that we shall need an imagination as intrepid as Herschel's to realise the state of the Sun, it is no less clear that it must be a vastly more creative imagination. Thanks to photography, of which M. Janssen has for so long given us such admirable examples, thanks above all to the spectroscope, which, in its latest applications in the spectroheliograph, actually maps out the forms of clouds of hydrogen and calcium at different levels of the Sun's atmosphere, we seem to have the means of gaining some real knowledge of the structure as well as the composition of the Sun's atmosphere. Nor are these the only signals that theory should hold its peace. A fresh discussion of the statistics of sunspots and prominences by Sir Norman Lockyer has shown

* The doctrine is not yet extinct; I have met persons, hardly in middle life, who learnt it at school, and held it without question.

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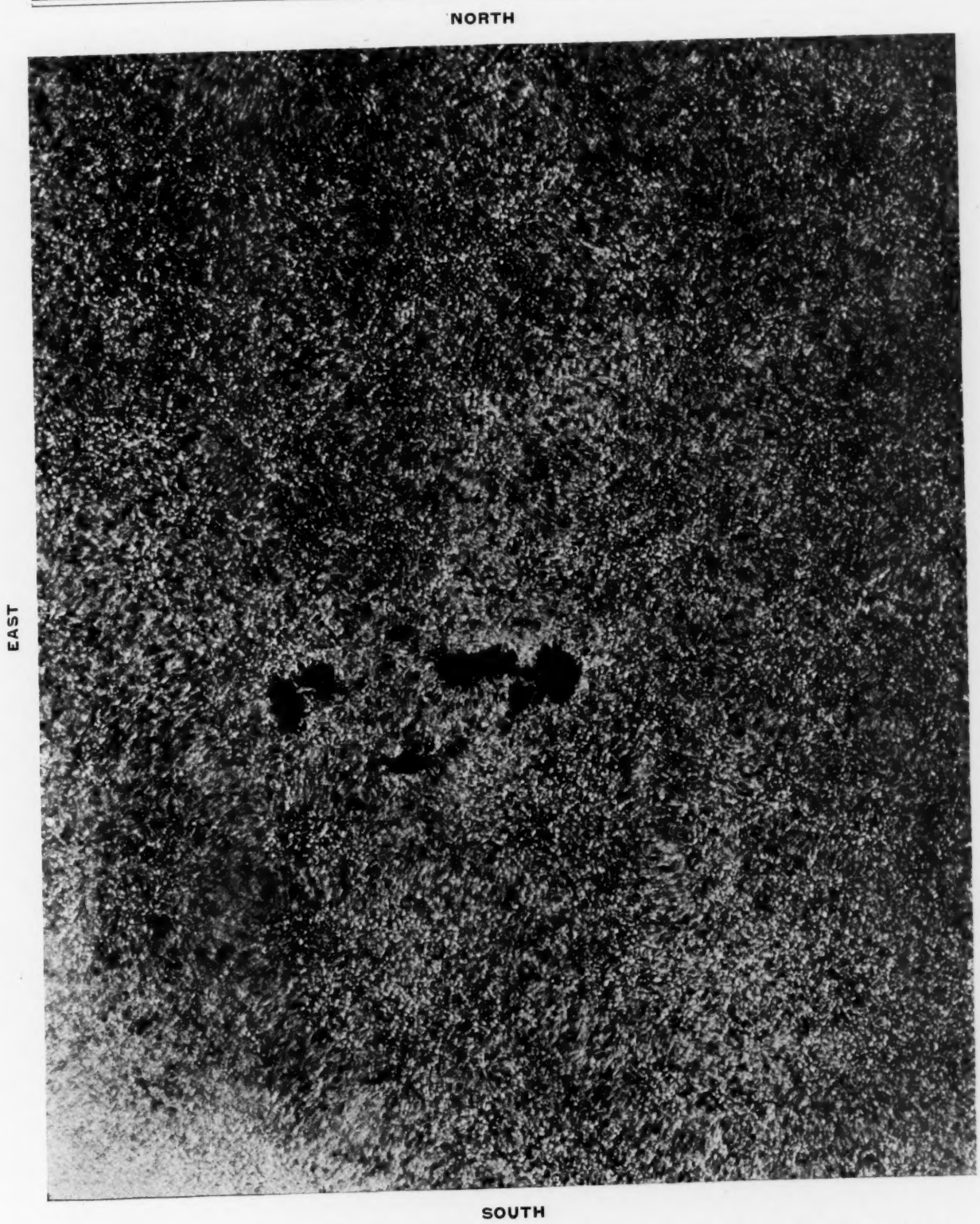
that the familiar eleven-year period is resolvable into the separate progresses of three or four simpler elements, which overlap one another and severally arise and disappear within seven or eight years; and a consideration of the Stonyhurst magnetic records by Father Cortie has served to prove how indefinable in the present state of our knowledge is the bond connecting magnetic storm with solar outbursts. In the presence of rapid and promising developments on the one hand, and increasing doubt upon the other, reserve in formulating any theory is unavoidable. No great confidence can be placed in arguments not based upon considerations which are of the widest generality, and cannot under any circumstances be falsified; such, for example, as the laws by which such a body must gradually condense under the influence of gravitation and loss of heat. Even here it is necessary to make somewhat sweeping assumptions before any precise conclusions can be drawn, and there is considerable disagreement among the results at which different authors have arrived. Yet I believe some plain and necessary outline can be drawn which will cover many of the most prominent facts. Though such an investigation relates more directly to the conditions prevailing within the body of the Sun than to the state at the surface, with which it might at first appear that we were alone concerned, its bearing upon the latter question is intimate. Thus Professor Schuster has said that the main difference between stars which show a spectrum like our Sun, filled with metallic absorption lines, and those which, like Vega, show only the absorption of hydrogen, is neither more nor less than the more thorough mixing up of the atmospheres of the former; "if we could introduce a stirrer into *α Lyrae* there can be no doubt whatever that the low-temperature lines of iron would make their appearance." If this be true, the stirrer we are seeking consists of more or less violent convection currents, and in order to form a just estimate of how efficient these may be we should study that instability which in great or small degree is always present where convection currents exist.

Instability with bodily interchange of material does visibly exist in the Sun, and must do so, or else its face would soon be covered with a dense mask of relatively cold matter; it is radiation which sets this instability up, and the key to understanding it is some comprehension of the process of radiation. For example, it should be realized very clearly that a comparison of the radiant energy emitted by two bodies is no comparison of their temperatures unless they are in similar states; thus a solid body maintained at a certain temperature radiates sensibly as from its surface; but if it be finely divided, and its parts scattered, it will radiate enormously faster from the same temperature, since its surface will be enormously multiplied. Hence, if a sunspot appears nearly black in comparison with the rest of the disc, or if, as in M. Janssen's photographs, we see the whole surface mottled over with minute brilliant spots upon a darker background, the simplest explanation is that the brighter parts represent matter diffused in cloud, and the darker parts are relatively dense and conglomerate.

In my opinion, the whole internal state is dominated by radiation, for apart from this source of loss of heat, there is no reason why the body should not settle down to any law of distribution of its matter in which the density did not increase from the centre outwards. But I must profess myself a total disbeliever in the state of affairs which it is commonly asserted would in consequence arise.

This state is Lord Kelvin's well-known "Convective Equilibrium" of temperature. Discussing in 1862 the state of the earth's atmosphere, and observing how winds and other currents mingled together with great rapidity portions of air which had been widely separated, Lord Kelvin adopted the hypothesis that the temperature at different levels must be such that this indifferent mingling should not change it; in other words, the excess of heat-energy possessed by a portion of air at a lower level of the atmosphere, and at consequently greater pressure and density, must be just sufficient to expand the same portion to a pressure and density in equilibrium with those at any level above to which it may be transported. The same law he afterwards adopted as regulating the whole internal state of the Sun, and many other eminent authorities have followed him, the latest and not the least of whom is Professor Schuster. If it is true of the Sun, we must allow that the Sun's density diminishes somewhat rapidly from the centre outwards, while the temperature from the surface to the centre rises with a great rapidity, which is maintained without much decline right throughout the whole body and reaches millions of degrees centigrade before one-tenth of the radius has been measured.

No doubt we must be prepared for some extravagances in theorising upon matters so little known, but it is at any rate safe to keep as far as possible from temperatures measured in millions of degrees; and in spite of the long acceptance of the theory of convective equilibrium in the Sun and the formidable array of authority by which it has been adopted, I confess I can find no reason why it should be supposed to exist. On the contrary it appears to me that if we can imagine it to be artificially set up, it would require forces to maintain it for which the circumstances make no provision. For if a body of gas were arranged according to this law, behind some screen which prevented it from losing energy by radiation, and the screen were then removed, what would happen? All portions would commence to lose heat, the outer portions very rapidly by mere radiation; but the inner portions also, in part by radiation, because they were less screened outwards than inwards, but chiefly because the outer chilled portions which had already lost the heat that allowed them to maintain themselves at the higher level descended upon them and shared in their stores. This would go on without any attempt on the part of the body of gas to restore the state of convective equilibrium, because no instability would occur which would give rise to convective currents mingling together the matter from separated regions, until the body had departed materially from the rapidly-varying density of convective equilibrium and had passed that of a density uniform throughout the mass. Even then the currents would only be proportionate to the degree by which a uniform density was overstepped, and except at the outer surface, where it is impossible to escape from a high degree of instability and consequently violent convective currents, the density would apparently be left in a state which might perhaps fluctuate a little, but would be but very little removed from a state of uniformity. It would follow that the temperature was also substantially the same throughout the bulk. Or again, if we reverse our attitude and suppose a body set up with density and temperature nearly uniform throughout its body, but on the whole very slightly increasing outwards and therefore liable to slight convective currents—excepting at the surface—and ask what forces would be found which could materially disturb such a state, none can be mentioned. Radiation which appeared as an acting cause tending to set up such a state will be inoperative when that state is attained—excepting again the surface—and conduction also, if we chose to consider it, would be inoperative with



Photograph of a Group of Spots and of the Granulations of the Solar Surface, taken at the Meudon Observatory, 1884, April 1, 10h. 46m., G.M.T.

a uniform temperature. At the surface, however, there will be a wide difference; between the rapid loss by radiation and the rapid restoring currents from below, no permanent or equable balance can be maintained; the slow currents from within, which tend to make their way outwards under the tendency of the bulk to settle down with greater condensation in its outward parts, here burst forth with a violence which all can see, and having parted with their energy, return nearly as precipitately. Radiation, then, is the dominating factor in the distribution of temperature and density within the Sun, and it will be noticed that in showing it to be so no assumption has been made as to the law by which it proceeds. If we wish to put our conclusions in a numerical shape, such assumptions cannot be escaped. For example, Stefan's well-established law of radiation, according to the fourth power of the absolute temperature from the surface of a "black body," does not apparently permit any conclusions to be drawn as to the law by which a gas would radiate. Between imperfect physical knowledge on the one hand, and mathematical difficulties on the other, nothing can be done except to produce a more precise illustration of the foregoing argument, and to show that the conclusions will stand scrutiny. This I have done in a paper published some nine years ago.*

There are two other general problems presented by the Sun which appear to invite solutions upon general mechanical principles. The first of these is the eleven-year period in solar activity. But as to an efficient cause for it, or even any calculable phenomenon which could follow its phases in a similar period, we seem to be still quite in the dark. An attempt has been made to reproduce such a period by a combination of tidal effects produced by Jupiter and Saturn; but the result is unconvincing, because the tide produced must be at most very minute, and the coincidence of period is dependent upon a hypothesis for which no reason can be assigned as to the relative intensity of effect of the two planets. In fact, we know as yet too little of the phases of this cycle to hope to theorise upon it successfully. Any real explanation must cover the more detailed description which Lockyer has given, to which allusion has been made above.

The second problem to which I refer is the law of rotation of the surface, by which the equator of the Sun rotates most rapidly, and parts in lower latitudes rotate more rapidly than parts in higher latitudes. The law was discovered by Carrington from motions of the spots, and was at first believed to refer to the spots, but in the hands of M. Dunèr, the spectroscope has proved that the property belongs to the whole photosphere. If we do not mark off the photosphere from the rest of the body of the Sun, this law contains, I believe, no mystery. If we suppose that in the course of its condensation in the past the inner strata of the Sun were to be found rotating faster than those outside them, it can be proved that as soon as the body had condensed to a compact fluid consistency so that the internal friction of its relative motions came into play, a law of rotation identical with that exhibited in the Sun would develop. But perhaps more striking, though less complete than a mathematical proof, is an illustrative experiment that was carried out some years ago by M. Béloposky, who filled a glass globe with water, carrying powdered stearin in suspension, and whirled it on a whirling machine until a uniform rate of rotation was taken up by the whole. The glass was then stopped and the motion of the water as exhibited by the particles in suspension was watched. The circumstances were now in substance just such as I have sketched above, and the apparatus exhibited just such relative motions as the Sun displays, individual particles travelling spirally from the equator towards either pole, with an angular motion which was less for greater latitude, ultimately passing inwards radially into the body. This last detail seems to convey also a suggestion of activities limited to special zones that may prove fruitful.

*Memoirs Royal Astronomical Society. Vol. LI.

Photograph of the Solar Granulations.

In the accompanying plate we give a reproduction on a reduced scale of part of one of the magnificent photographs of the solar surface, recently published by M. Janssen in the "Atlas," which we noticed in the April issue. The wonderful manner in which the minute structure of the solar photosphere is brought out in M. Janssen's superb photographs is due principally to the care which he has taken to secure two points—the one that the photograph shall be taken by light which is practically monochromatic, so that the image is as sharp as it is possible to obtain it; the other that the exposure shall be extremely short, so as to accentuate minute differences of brightness in the most luminous portions of the disc. It will be noted that the photograph is so under-exposed that in the present reproduction the penumbræ of the spots are perfectly black. They were not absolutely featureless in the original, but were exceedingly faint, the darker portions of the sun being thus sacrificed in order to secure the maximum of detail in the more brilliant parts. The intensely granular nature of the disc and the thatch-like structure between the spots are very clearly seen. This particular region of the sun does not show any strongly developed instance of the blurring of the granules; but here and there small smudged regions show themselves.

The original of this photograph was taken on April 1, 1884, at $10^h\ 46^m$ G.M.T. The group of spots in the centre of the field is the one numbered 1343 in the Greenwich series. It was a sudden outburst, the day of the photograph being only the second of its existence. Its area at the time was 177 millionths of the sun's visible hemisphere, or slightly over 200 millions of square miles. The group increased in size with great rapidity. On April 2 its area was nearly five times as great as on April 1, and by April 6 the group was one of the largest seen during the entire 1882-1884 maximum. It returned to the visible hemisphere on April 21. During the thirteen days that it was under observation at this return, it was gradually diminishing in area; the leader spot being as usual a circular spot of regular structure, and much more stable than the rest of the group. Before the group disappeared at the west limb on May 3, the leader was the only survivor. The leader was seen again, still as a well-marked circular spot, during two further returns. It slowly diminished in size, and was last seen on July 12, when it had shrunk to an area of no more than six millionths of the solar hemisphere. The entire life of the group was thus 103 days.

The scale of the accompanying photograph is one of 33 inches to the diameter of the sun.

Mr. J. W. Jarvis, F.G.S., St. Mark's College, Chelsea, S.W., has been appointed Class Secretary and Class Treasurer to the London Geological Field Class. The excursions this season are to Merstham on April 30, and to Purley, Henley, Wimbledon, Aylesford, Leighton, Bedford, Chislehurst on succeeding Saturdays.

NOTES.

ASTRONOMICAL.

Comet 1904, *a* (Brooks).

AFTER an interval of seven months, during which no comet has been under observation in the northern hemisphere, a new comet was discovered by Professor W. H. Brooks, Director of the Smith Observatory, Geneva, U.S.A. The new object, as the following elements by Herr E. Strömgren will show, has almost exactly the same perihelion distance as the comet discovered by M. Giacobini, December 2, 1902. Only one other comet is known with a perihelion distance greater than these, namely, that of 1729. An examination of the Harvard photographs taken before the discovery of Brooks' comet furnished six plates, showing objects which might possibly be identical with it. These were taken on March 11 and 15, and April 1, 5, 13, and 16. The first two places have not as yet been satisfactorily included in any orbit, and possibly the images shown on these two plates do not in reality belong to the comet. The nebulæ N.G.C. 6555 and 6564 are in the immediate neighbourhood of the place indicated by the plate of March 11. At the present time the comet is receding both from the earth and from the sun, and is slowly diminishing in brightness. This makes the twenty-fourth comet discovered by Professor Brooks.

ELEMENTS.

T = 1904, Feb. 28, 8130 M.T. Berlin.
ω = 50° 51′ 30″
Ω = 275° 17′ 36″ } 1904·0
i = 124° 59′ 38″
$\log q$ = 0·42951

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Methods of Determining Jovian Longitudes.

In the "Monthly Notices" of the Royal Astronomical Society for March, 1904, Mr. Stanley Williams institutes a comparison between the method of determining the longitude of markings on Jupiter by estimating the times when they appear to be exactly in mid-transit with the method of measuring their distances from the two limbs of the planet by a micrometer; and he gives good reason for thinking that the first and simpler method is, in the hands of a practised observer, not at all inferior in accuracy to the latter. The micrometric method has been supposed the better from the comparison of measures of the same object made on the same night; obviously transits of any object can only be compared as taken on different nights. Mr. Williams has in this paper compared micrometric measures made of objects on different nights, and finds that they show no superiority in accuracy over the method of transits.

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Change from Taurus to Aries as First Sign of the Zodiac.

The same number of the "Monthly Notices" contains a paper by Mr. and Mrs. Walter Maunder, in which they show that there are clear indications in Assyrian records of two distinct methods having been in use for the determination of the beginning of the year. The earlier was that of the seleniacal setting of Capella. This involved the recognition of Taurus as the first constellation of the zodiac, and was no doubt in operation as early as 2000 B.C. The second was the direct determination of the equinox by some form of time-measurer. Other advances in connection with this seem to be indicated: the recognition of the ecliptic as distinct from the equator; of the ascending node; of the nature of the motions of some at least of the planets; and the division of the ecliptic was effected into twelve equal signs as distinct from the twelve irregular constellations. The date when these changes took place cannot have been very different from that when the star Hamal, the brightest of the constellation Aries, marked the spring colure, *i.e.*, about 700 B.C., and the remarkable outburst of scientific activity which is thus indicated was in all probability associated with the great literary activity of the reign of Assurbanipal.

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The Astrographic Catalogue.

It is now seventeen years since the delegates of seventeen different nationalities met in Paris, under the presidentship of Admiral Mouchez, to consider the question of a photographic chart of the whole heavens, down to the stars of the fourteenth magnitude, with a catalogue of stars to the eleventh magnitude. The latter portion of the programme is now beginning to be realised; the Potsdam observatory has already produced three volumes of its catalogue; the observatories of Helsingfors, of Paris, and of the French colonies have also begun to publish; and the Astronomer-Royal, at the meeting of the Royal Astronomical Society, already alluded to, presented the first volume of the Greenwich catalogue, covering one half the Greenwich section. The introduction to the catalogue contains a number of exceedingly interesting discussions; of the effect of personality on the measurement of the places of stellar images, of the probable error of the measures, and of the determinations of photographic magnitudes. The accuracy of the measures of position are of the same order as of observations with the transit instrument; the probable error of the position of a star, in arc of a great circle, deduced from the measures on one plate is ± 0·26″ in R.A., and ± 0·28″ in Declination. In the investigation of photographic magnitudes, it was found that in passing from one exposure to another the law, exposure × brightness equals constant, held almost exactly, except in the case of the shortest exposures, which gave fainter stars than would be expected in accordance with the law.

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Distribution of Stars of the Third and Fourth Type.

In a discussion of the distribution of the coloured stars, Herr Freidrich Kruger gives in the "Astronomische Nachrichten," No. 3947, a table dealing with 3800 stars of the third and fourth types of spectra. These are distributed into eight zones, each twenty degrees in breadth, the galactic equator running through the middle of the fifth zone. The table shows that about 4 per cent. of the stars of the third type of spectrum are known to be variable, but 14 per cent. of the fourth type. Both cluster towards the galactic equator, but that clustering is much more evident with the fourth type stars. These two relations were drawn attention to by Professor Hale in his recent "Memoir on Stars of the Fourth Type." A curious point of difference between the two types is shown by Herr Kruger's table, namely that whilst the numbers of the third type show but very small increase with diminution of magnitude, the faintest class of the fourth type includes more than all the other six classes combined.

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The Spectroscope Binary, Iota Pegasi.

Professor W. W. Campbell discovered in 1899 that Iota Pegasi was a spectroscopic binary, and Mr. Heber D. Curtis, from a very thorough discussion of forty-three photographs of the spectrum extending over six years, has obtained very accurate final elements for it. The period found is 10·21312 days, and the velocity —4·12 kilometres. The orbit is nearly circular, the eccentricity being 0·0085, so that the epoch of periastron is not very certain. Dr. R. G. Aitken examined the star in 1901 with the 36-inch refractor of the Lick Observatory, but was not able to detect any evidence of duplicity.

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The adaptation of the Forty-Inch Visual Refractor of the Yerkes Observatory to Photography.

In the original design of the forty-inch refractor of the Yerkes Observatory, no provision of any kind was made for direct photography; there is no guiding telescope to enable lengthened exposures to be given, nor photographic corrector to bring the actinic rays to a focus on the sensitive plate. Mr. G. T. Ritchey has overcome the first difficulty by means of an eyepiece magnifying about one thousand diameters, placed in the side of a double-slide carrier. A small diagonal prism receives the light of the guiding star, and reflects it at right angles into the eyepiece, and this with its accessories are mounted on a slide which can be moved to any desired position on the upper side of the rectangular box, and firmly clamped there, so as to assist in finding a suitable guiding star. The star is brought to the intersection of the cross-lines in the eyepiece, and is kept there throughout the exposure of the sensitive plate. The observer sits with his eye at the guiding eyepiece and his fingers on the two screws which move the slides, and thus he introduces any minute corrections of position which he sees are necessary. These corrections may be on account of either the irregular movements of the driving clock of the telescope, or more frequently from the tremors in the atmosphere. The latter irregularity may require correction several hundred times in a minute, and a practised observer can introduce between one and two hundred per minute. The other difficulty—that the instrument is a visual one—Mr. Ritchey has obviated by the use of a delicately tinted yellow screen. This screen utilises the rays of light which are most freely transmitted by a large objective; since it is a well known fact that while only a small percentage of the yellow rays are lost by transmission through a large and necessarily thick objective, a very large percentage of the blue rays are. Consequently the forty-inch visual objective, thus used with a yellow screen, and plates sensitised to the yellow rays, is scarcely less rapid, if at all, in photographing stellar images, than an object-glass corrected for blue rays would be. In two hours it registers stars of approximately the seventeenth magnitude, which are at the visual limit of the instrument; and in five hours can register stars of a magnitude fainter. The yellow screen is formed from two thin and transparent plates, finely ground flat and highly polished. One of these plates, which are 8 by 10 inches, is flowed over with a collodion film of a delicate yellow tint, and when the film is dry, this is covered with Canada balsam, and the other plate bound on it as a cover glass by adhesive tape. When in use it is laid close upon the sensitive plate, nothing separating them but the tape. Mr. Ritchey has been most successful in photographing portions of the moon's surface, and close clusters of stars, and in Vol. VIII. of the Decennial Publications of the University of Chicago, several very fine specimens are given, notably one of the lunar crater Theophilus and its surroundings, which perhaps shows the detail on the moon's surface more clearly than any other photograph ever taken. In the photographs of the clusters Messier 13 and 15, the original negatives and transparencies from them show the star images separate and distinct, even at the very centre of the cluster, but in the process reproductions given in the volume the smaller and nearer stars are merged together. With nebulæ the yellow screen is not so successful since these are rich in their proportion of green rays, which do not come to the same focus as the yellow.

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Photographs with the Two-Foot Reflector of the Yerkes Observatory.

Seven very fine specimens of the work done with the two-foot reflector of the Yerkes Observatory are published in Vol. VIII. of the Decennial Publications of the University of Chicago. These are of the two giant nebulæ of Orion and Andromeda; of the spiral nebulæ Messier 33 Trianguli and Messier 51 Canum Venaticorim; of the carded-wool-like nebulosity in the Pleiades; and of the torch-like nebulæ in Cygnus known as N.G.C. 6960, and N.G.C. 6992. These two last form part of the same extended nebulosity, but they present some striking differences in their relationship to the stars. In the first case the nebula seems to act as a wall or barrier separating a region strewn very thickly with stars, from a sparser field; in the other case no such difference in the number of the stars seems to exist on the two sides of the nebula, which itself appears to lie in a district of few and small stars.

ZOOLOGICAL.

Mosquitoes in England.

DESPITE the coldness and wetness of the season, mosquitoes, according to the "Report on Economic Zoology," issued by the Trustees of the British Museum, appear to have been unusually numerous in England last summer, and to have caused much annoyance and inconvenience. They were very prevalent in parts of Essex, especially in the neighbourhood of Epping Forest, and also in Kent and Surrey, notably along the valleys of the Thames and the Kennet, and in the marshes bordering the lower courses of the Thames and the Lea. They were also reported as having caused much annoyance near Bristol, at Great Staughton, Huntingdonshire, and at Weston-super-Mare, Worplesdon, Colchester, Canterbury, and Birchington. Although complaints of mosquito bite are received almost yearly from the Thames Valley, last summer the insects in question seem to have been unusually virulent, causing such swellings that medical attendance was in some instances requisitioned. The species most abundant were the common gnat (*Culex pipiens*) and the banded gnat (*Theobaldia annulata*), the latter of which does not usually attack man. This reminds us that we fail to see the reason for dropping the good old English word "gnat" in favour of the foreign "mosquito," now that both are known to be the same.

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A Deer-like Antelope.

Hitherto there has been supposed to exist a sharp distinction between deer and antelopes, according to the nature of their horns; but recent discoveries in North America tend to show that this distinction is only a feature of the present day. Deer, it is almost superfluous to mention, have deciduous bony antlers, while in antelopes the horns are covered with hollow sheaths, which are never shed and never branched. The American prongbuck resembles antelopes in its skeleton, but its horns are forked. The new fossil type combines the skeleton and teeth of an antelope with the antlers of a deer.

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New British Mouse.

According to a note by Mr. W. E. Clarke in the Proceedings of the Royal Physical Society of Edinburgh, the mouse of the Færoe Islands is a large and stouter built animal than the common house mouse, from which it also differs in colour. It is therefore regarded as representing a distinct local race of that species. St. Kilda has also a peculiar mouse of its own.

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A Rare Bird at the Zoo.

The Zoological Society's menagerie in the Regent's Park has recently received an interesting and valuable addition in the form of a specimen of the South American boat-billed stork (*Canchroma cochlearia*). It is many years since this species, which, by the way, must not be confounded with the shoe-bill of the White Nile, has been represented in the collection.

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New Egyptian Fossils.

Great interest attaches to the description by Dr. Fraas, of Stuttgart, of certain very remarkable fossil mammalian remains from Lower Tertiary marine strata in the Mokattam range, near Cairo. These specimens serve to show that a gigantic Tertiary whale-like creature, known as *Zeuglodon* (of which the remains were first discovered in North America), is the direct descendant of the primitive land Carnivora of

the early Tertiary; the newly-discovered forms being actually the missing links. Hitherto, *Zeuglodon* itself has been generally regarded as an ancestral type of whale, but this, according to Dr. Fraas, is incorrect; that creature, although marine, having no sort of affinity with the Cetacea. If this be so, we have still other missing links to discover, namely, the progenitors of the latter group.

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Fish Scales.

We may now, it seems, ascertain the age of the cod and haddock sent to us by our fishmonger by the examination of their scales. For it appears, according to recent researches, that the scales of these fishes, like those of carp, develop at intervals certain well-marked rings, which appear to indicate the limits of the annual growths.

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An American Hedgehog.

The discovery in the middle, or Oligocene, Tertiary deposits of Dacota of the remains of an extinct species of hedgehog may not appear to non-zoological readers a matter of much importance. In reality it is a fact of the very greatest interest, for hitherto the hedgehog tribe (*Erinaceidæ*) has been regarded as an exclusively Old World group. The discovery of the fossil American species (which has been made the type of a new genus, under the name of *Protherix*, and is described in the XIXth volume of the *Bulletin* of the American Museum) serves to strengthen the view of those who maintain that the northern countries of both the Western and Eastern Hemispheres form but a single zoological region; and that formerly there was comparatively free communication between them in the neighbourhood of Behring Sea, under climatic conditions which permitted of temperate forms passing from one continent to the other. When we know more of the Tertiary fauna of Eastern Siberia, it is probable that the number of groups of animals confined to one or the other hemisphere will be still further diminished.

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Fish Destruction by Birds.

At a recent meeting of the Belfast Natural History and Philosophical Society, Mr. J. Brown gave reasons for concluding that there are 2,000,000 gulls in the United Kingdom, and that during the herring season each bird destroyed 200 fry per day, or 12,000 during the two months of the season. These, if they had come to maturity, would have been worth £24,000,000. He, therefore advocated the destruction of the gulls, each of which cost the nation £12 in two months in consequence of their protection by Act of Parliament. If we add to the damage done to herrings by gulls the loss inflicted on these and other fishes by cormorants, shags, gannets, guillemots, &c., there can be no doubt that the supply of food fishes is enormously diminished; and it seems little short of folly to be spending vast sums of money on the maintenance of fish-hatcheries at Piel and other places, and at the same time to do all we can to ensure the destruction of valuable fishes by encouraging the increase of their natural enemies. Birds, are, no doubt, charming adjuncts to scenery—both on the coast and inland—but such ornaments may be bought too dearly.

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The Destruction of Whales.

In the course of a very interesting paper on whales and whaling contributed to the April number of the *Annals of Scottish Natural History*, Mr. T. Southwell tells us that whereas between the years 1814 and 1823 no less than 12,907 Greenland whales were killed off Greenland and in Davis Straits by British vessels, only 127 were accounted for in the ten years ending with 1902. Comment is superfluous.

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Papers Read.

At the meeting of the Zoological Society, held on April 19th, Mr. O. Thomas exhibited the skull and skin of a hartebeest from Uganda, which were regarded as representing a new species; and also skulls of the North Australian rock-wallaby, a species remarkable for developing an unusually large series of molar teeth, which are continuously shed and renewed. This same gentleman, in collaboration with Mr. Schwann, read a paper on twenty-one species of mammals collected during the work of the Boundary Commission between British and German East Africa, of which three were regarded as new to science. Mr. Beddard contributed the second instalment of a series of papers on the anatomy of lizards, dealing in this instance with the South American teguixin; Mr. Boulenger gave additional information with regard to the skeleton of the extinct Scots reptile *Telerpetum*; while Dr. Broom described the structure and mode of articulation with the skull of the lower jaw of some of the extinct mammal-like reptiles of South Africa. Finally, Mr. Druce gave descriptions of three-and-twenty new South American butterflies. At the meeting of the same body on May 3rd the following four papers were read, namely: Mr. Thomas on the osteology and systematic position of the Malagasy bat *Myxopoda aurita*; Mr. Beddard on certain features in the vascular system of chameleons and other lizards; Mr. A. D. Imms on the gill-rakers of the sturgeons of the genus *Polyodon*; and Dr. Ridewood on the skulls of certain bony fishes. A sketch was exhibited of a young African elephant remarkable for the amount of hair on its body; and a photograph was shown of the last Quagga living in the menagerie. At the Geological Society on April 27th, a new species of fossil scorpion from the coal-measures of Lancashire was described by Messrs. Baldwin and Sutcliffe.

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Mr. W. Royal-Dawson writes:—With reference to the Note in last month's "KNOWLEDGE" (p. 96) on the prior opening of the right eye, I may state that out of a litter of eight tame white rats born a short time ago no less than seven opened the right eye first, while the eighth showed no tendency to do so. I think this will suffice to confirm the supposition that the right eye is the first to be opened in the order *Rodentia*.

BOTANICAL.

AN abstract of Mr. G. Massee's interesting paper "On the Origin of Parasitism in Fungi," which has recently been published in full in the *Philosophical Transactions* of the Royal Society, is given in the Society's *Proceedings*, and also in the *Annals of Botany* for April. The author explains why it is that a certain parasitic fungus is often only capable of infecting one particular species of plant. Though the spores of these fungi germinate freely on the surface of any plant when moist, infection is confined to the particular species of plant which is the usual host of the parasite. This selective power is attributed to chemotaxis. The presence of saccharose in the cell-sap of the host plant is found to induce infection by many saprophytic and parasitic fungi, unless the influence of this attractive or positively chemotactic substance is overcome by the presence of a more powerful negatively chemotactic or repellent substance. Apples, though containing saccharose, are immune from the attacks of *Botrytis cinerea*, which preys on a greater number of different plants than any other known parasitic species. This immunity is due to the presence of malic acid, which is repellent or negatively chemotactic to the germ tubes of this particular fungus. Experiments have shown that a fungus can be induced to attack the leaves of a plant, on which it is not ordinarily parasitic, by injecting into them the substance which is known to be positively chemotactic to its germ tubes.

In the *Annals of Botany* for April, Mr. J. Parkin calls attention to the nectaries on the bud-scales of the Para Rubber tree, *Hevea brasiliensis*, apparently the only plant that possesses them on these organs. The Euphorbiaceæ, to which *Hevea* belongs, contain numerous species in which extra-floral nectaries are present, usually on the stem or on the lamina or petiole of the leaf. *Hevea* also has them on the leaves, and various references to these have been made by writers, but the nectaries on the bud-scales seemed to have been overlooked altogether. This is probably due, as the author

explains, to the fact that an adult tree of the *Hevea* "puts forth fresh foliage annually, and the bud-scales being caducous, are merely evident while the shoots are in the immature condition." The honey secreted by the nectaries encourages the visits of ants, whose presence assists in safeguarding the developing foliage from the attacks of injurious insects.

PHYSICAL.

The Emanation from Radium Bromide.

To show the diffusion of the emanation from radium bromide, Mr. T. Indricson, in a paper recently read before the Russian Physico-Chemical Society, used a long tube, the internal surface of which was coated with a layer of zinc-sulphide. On connecting the apparatus with a test-tube containing a solution of radium bromide, luminescence was found to appear and to be propagated throughout the tube. On repeating Ramsay's experiments, the author found that the yellow helium line did not coincide with the yellow lines of the spectrum given by the emanation, but was situated between the two yellow lines of the emanation. When the serpentine coil communicating with the tube was dipped into liquid air, a strengthening of the lines corresponding to the helium line was noted in the spectrum of the emanation, while between the two yellow lines above referred to a third line, coinciding with the yellow line of helium, appeared. The lines of helium do not exist in the spectrum given by the emanation of a freshly-prepared tube, but only appear afterwards. On observing the gases set free on the dissolution of radium bromide, it was observed that the helium lines did not appear as long as the spectrum tube preserved its phosphorescence in the dark. After four days this phosphorescence would disappear, and the lines of helium could be noted in the spectrum.—A. G.

* * *

Action of Radium on Metals.

In order to investigate the action of radium on metals, N. Orloff, as pointed out in a paper recently read before the Russian Physico-Chemical Society, covered, in April, 1903, an ebonite capsule containing 0·03 gm. of radium bromide with an aluminium plate 0·01 mm. thick, instead of the mica generally used. In the course of July the author, on opening the capsule, noted on the surface of the aluminium turned towards the radium some protuberances of the same aspect as the surrounding surface of the aluminium, and resembling small drops of melted metal. These protuberances proved to be radio-active, producing a photographic image on acting for some minutes through black paper; and even after six months they were found to emit invisible radiation without any appreciable weakening. The author thinks that a stable alloy is formed by the accumulation of material particles given off from the atomic systems of radium, around small aluminium nuclei.—A. G.

* * *

On Radio-Active Emanation from Water and Oil Fountains.

In a paper published in No. 8 of the *Physikalische Zeitschrift* (April 15, 1904), Prof. F. Himstedt arrives at the conclusion that radio-active bodies giving off a gaseous emanation are widely diffused throughout the earth; these emanations are absorbed by water or by petroleum, and after having been conveyed along with the latter to the surface of the earth, will thence diffuse into the air. Because of the many analogies noted between these emanations and radium emanations, the author thinks it possible that both are identical. In this case the ores of uranium, from which radium emanations are derived, would either be widely diffused or else there would be some further matters possessing, though to a lesser degree, the property of giving off emanations. Considering that the absorption coefficient of water, as well as of petroleum, with respect to this emanation, is found to decrease for increasing temperatures, while hot fountains, on the other hand, show an especially high activity, the hypothesis is suggested that the amount of radio-active mineral increases with increasing depth. The radio-active components of the earth should, therefore, possibly be allowed for in estimating the temperature of the earth's mass.—A G.

ORNITHOLOGICAL.

By W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U., &c.

Gloss yIbis in the Orkneys.

THE "*Annals of Scottish Natural History*" for May contains an account of a Glossy Ibis, *Ibis falcinellus*, shot a mile west of Stromness on September 19 last. According to Mr. Eagle Clarke this is only the second occurrence of this bird in the British Islands, the first having been shot in 1857 near Kirkwall. Some mistake has certainly been made here; for which Mr. Eagle Clarke can hardly be responsible. So good an ornithologist doubtless knows that at least thirteen instances of its occurrence in Great Britain are recorded, one of these being from Aberdeenshire—October 4, 1880. According to Mr. Ussher there are no less than twenty-two instances of its occurrence in Ireland.

* * *

Rough-Legged Buzzard in Co. Down.

The Rough-legged Buzzard, *Buteo lagopus*, is only a rare visitor to Ireland. According to the *Irish Naturalist* (May) a specimen was shot in November last in Co. Down—the fifth in Down. This appears to be the tenth recorded instance of its occurrence in Irish territory.

* * *

Stone-Curlew: Co. Donegal.

An example of this rare visitor to Ireland was obtained on October 12 last in Co. Donegal. This is the first time of its occurrence in Donegal. Only ten other cases of its occurrence in Ireland are on record, and eight of these, it is interesting to note, were obtained on the East Coast.

* * *

Ravens Nesting in Captivity.

Instances of ravens breeding in captivity are rare; and cases of successful rearing are still more so. Mr. W. H. St. Quintin's note in the *Field* (May 7) to the effect that he has in his aviary a pair of young that are nearly ready to leave the nest is therefore of considerable interest, especially so having regard to a certain police court prosecution which took place some time ago.

* * *

Great Crested Grebes at Richmond.

Mr. Gordon Dalgliesh sends us some interesting notes on a pair of these birds which he has had under observation since April 17 last. They have taken up their quarters in the Penn Ponds and appear to be breeding. When preening the breast feathers, he remarks, these birds turn over on to their backs and do not perform this operation when sitting upright as one would imagine. "The female, when she landed, did not stand upright, but dragged herself along on her belly."

* * *

Colour, and Coloration in Birds.

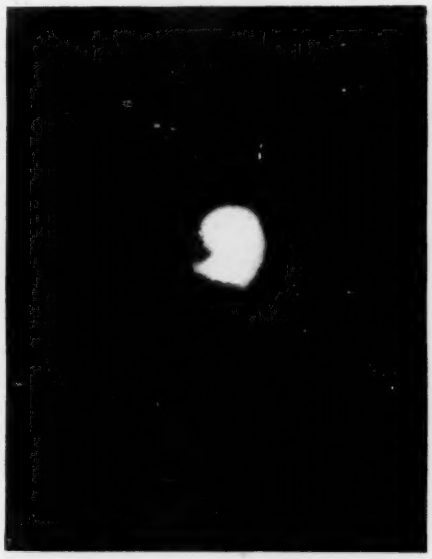
An extremely interesting and important paper on this subject was read by Mr. T. Lewis Bonhote at the Linnean Society on May 5, to which we hope to be able to refer later. Briefly, he contends that both colour and coloration are primarily due to physiological causes, and that the varied patterns and tints of plumage which distinguish different species are determined by the action of natural selection on these "expression points" of "vigour."

There is an intimate connection, he contends, between the bleaching process which takes place previous to moulting, and the development of conspicuously marked areas. These indeed, he holds, are nothing more than permanently fixed bleaching, or intensification areas, which he terms "pœcilomeres."

Messrs. Newton and Co., who have held appointments to the Royal Family continuously since 1860, have this week been honoured by a Warrant of Appointment as Scientific Instrument Makers to H.R.H. the Prince of Wales.

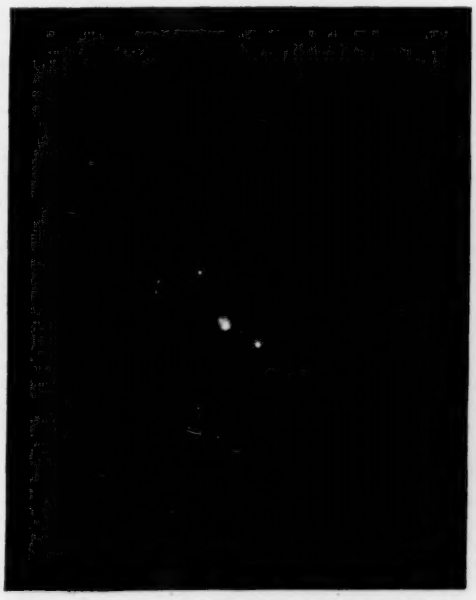
Bacteria and Radio-Activity.

BY the kindness of Dr. Alan Green we are able to reproduce two photographs showing the effects that bacteria which have been submitted to the action of radium bromide, produce



Tuberculosis Bacilli.

on photographic plates. Small masses of bacterial growth were exposed to the β and γ rays of 10 milligrammes of virtually pure radium bromide. In a large number of instances such masses when removed from the influence of the radium and placed between two thin sheets of glass, themselves not radio-active, were capable of so affecting the sensitised film of a photographic plate with which they were brought in contact that, on development in the ordinary way, the plate showed a dark area corresponding to the shape of the bacterial mass. The photo-actinic rays proceeding from the bacteria which had been exposed to radium were capable of affecting a photographic plate through a double layer of lead foil. The rays thus emitted seem to coincide with the β rays of radium, for they are stopped by a sufficient thickness of lead. If any γ rays are emitted by the bacteria they do not appear to affect the photographic plate. It will be remembered that some years ago Dr. Johnstone Stoney remarked that the microscopic dimensions of bacteria might be due to the necessity of deriving their energy from the slower moving molecules of substances with which they were in contact, and more lately it has been suggested that the energy of radium might be due to the analogous power of that element to derive its energy from outside sources by sifting out the molecules of different speeds impinging on it. This theory, now received with less unanimity than the Rutherford-Ramsay-Soddy theory of the disintegration of the atom, is neither confirmed nor disproved by Dr. Alan Green's experiments, which appear to show that bacteria, so far as acquired radio-activity is concerned, behave like other substances. One of our photographs shows the blur made by a mass of tubercle bacilli on a plate; the other the effect similarly produced by anthrax spores. The acquired radio-activity lasts in some instances for over six weeks.



Spores of Anthrax.

A Stereoscopic Single Lens.

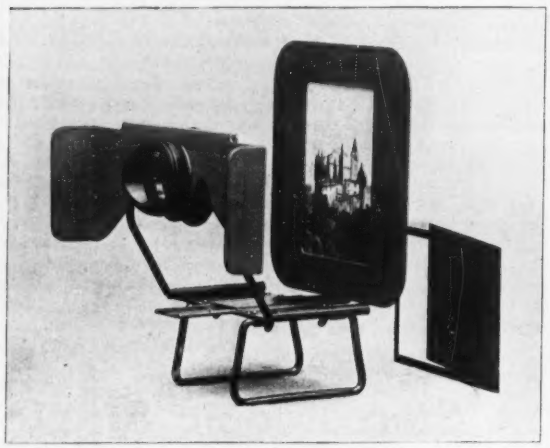
A NEW method of obtaining stereoscopic photographs, and stereoscopic effects when looking at them, has been designed by Dr. M. Von Rohr, of the Carl Zeiss firm. Its peculiarity is that the effects are obtained by a single lens directed at single

Viewing through the Single Lens Stereoscope.

XUM

photographs. The photographs are taken with objectives of a focal length below that of the range of distinct vision, which in normal sighted people is about ten-and-a-quarter inches. Such a photograph viewed in the ordinary way would appear to be out of perspective and its parts out of proportion, though some of this impression could be to some extent removed or remedied by magnifying the photograph.

The accompanying figure indicates a method by which the



Single Lens Stereoscope, with Photographs.

eye can obtain a virtual distance-image magnified of the photographs. The apparatus will, in the case of normal vision, bring the different parts of the photograph under the same visual angles as those obtaining at the moment of photographic exposure. An achromatic magnifying lens is used, the focal distance of which is similar to that of the objective used in photographing the object, and which is free from distortion for objects situated at $1\frac{1}{16}$ inches from the nearest lens

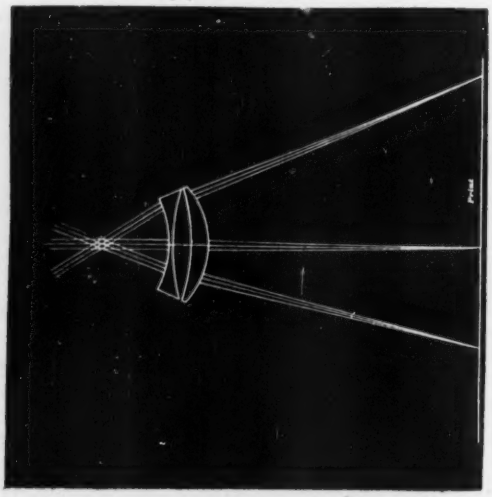


Fig. 3 (Single Lens Stereoscopy).

surface. The lens (fig. 3) is free rom astigmation but not from curvature of field. Therefore when using it the accommodation of the eye must be altered according as the central part or the marginal part of the photographic print is under inspection; and the nature of the eye accommodation will vary for short-sighted, long-sighted, and old-sighted people. But if all the directions are carefully followed, an eye of normal vision will perceive through the lens, not the photograph as it appears to the unaided eye, but a far distant image of it, free from distortion, and under the same conditions of apparent size, distinctness, perspective, light and shade as those under which the objects themselves would be seen with the short photographic objective that has been mentioned. Consequently the small photograph thus conveys to the eye a much more natural effect than a landscape photograph can possibly do; and unconsciously the vision forms in the mind a correct perception of relief and distances. Thus although the stereoscopic effect is not of the same kind as that produced in ordinary stereoscopes, the effect of solidity is strongly evident and perceptible. A.G.

"Osprey" Plumes, Real and "Artificial."

By W. P. PYCRAFT, A.L.S., F.Z.S., &c.

WITHOUT doubt the most beautiful of feather ornaments is that commonly known as the "Osprey" plume. How this name came to be used is a mystery, for the feathers in question are not obtained from the Osprey, which is a bird of prey, but from various species of Herons, those known as "Egrets" furnishing the most highly prized varieties. It is from the French form of this word Egret, that the term "aigrettes," often used instead of "Osprey," is derived. Naturally, the possibilities of these plumes as head-dresses, both for men and women, have been widely appreciated. Only in the Army, however, have they been worn by men in this country, and the practice has now been happily abolished. To induce our countrywomen to follow this lead, the most strenuous efforts have been made within recent years to spread a knowledge of the consequences which follow from the encouragement of the traffic created by their demands. Though at last there seems some prospect of success attending these efforts, unless progress towards this end is more rapid, the extermination of the hapless victims is inevitable. This in itself would be an end much to be deplored, but the nameless suffering and pain, which accompanies this extinction, makes the "passing of the Egret" a pitifully sad story.

To many women the broad outlines at least of this matter are already well known, and, as a result, numbers have decided to leave such ornaments severely alone. Others, unable to break the spell wielded by these seductive plumes, have compromised, by forswearing what they believe to be real "Ospreys," and wearing, instead, what they fondly imagine to be an artificial product.

In purchasing "Ospreys," at least in most milliner's shops, whenever scruples are manifested, the assistant professes to have doubts about the genuineness of the plume, retires to the Manager, and returns, assuring the anxious customer that a mistake has been made, that, after all, the plume is artificial. This fact, long known to the authorities at the British Museum, was shamelessly admitted, only a few days ago, by the Manager of a large shop in London. "But ladies," he remarked, "are hard to please. . . . Their consciences have to be soothed, and the assistant, rather than lose valuable custom, readily sells the article as artificial!"

In the wholesale trade the word artificial appears to have been used in a technical sense, long before the agitation against the wearing of "Ospreys" began. Inferior "Osprey" plumes and feathers of birds other than Egrets or their allies, which have been disguised to simulate "Ospreys," are known by the wholesale buyers as "*artificials*."

But let it be distinctly understood that the assertion of the retail milliners, that the plumes sold by them as artificial are made of quills split up, or of whalebone, or of any other material, are *absolutely false*.

The broad facts concerning "Osprey" or "aigrette" plumes and their origin are briefly these. The "aigrettes" of the milliner are the long, loose, waving plumes taken from the backs of different species of small Herons, the white plumaged species, some ten in number, being the most valued. The finest kinds are those from the Little Egret, *Garzetta garzetta*, and the Black-footed Egret, *Garzetta nigripes*. In both species the plumage is pure white, and the long "train" feathers are of a peculiarly loose, flowing type, of great delicacy, and recurved at the tip. It is this latter peculiarity that gives them the peculiar value. The little Egret occurs in Southern Europe, China, and Japan, S. Burma, India, Ceylon, Malay Archipelago, and Africa.

Fig. 1.—Three plumes of a white Egret, *Garzetta garzetta*, used for the purpose of making "ospreys" or "aigrettes." Note the extreme length and slenderness of the "barbs" or thread-like branches of the feather.

The black-footed species has a more restricted distribution, being found only in Java, the Molluccas, and Australia.

A third species, *Leucophoyx candidissima*, also produces recurved plumes, but these are not so fine as in the two just enumerated. This bird occurs in temperate and tropical America.

In all the species on which this war is waged, some 16 or 17 in number, these feathers are of great length. In some—*e.g.*, *Mesophoyx intermedius*—they may attain a length of 17 inches. From a bundle of such, as many as four separate plumes could be cut. The delicate terminal portions of the feathers furnish the "genuine Osprey" of the wholesale trade, and fetch a high price; whilst the three lower segments are sold as "artificials" often at a ridiculously low price—so low that it has often been contended that they could not on that account be real feathers. But the tips pay for the whole bundle and leave a profit; the lower portions of the feather, therefore, may well be sold cheap.

Besides the white Herons—some ten species in all—there are several others laid under contribution. These birds are of varied colours, and the plumes are sold as "red" or "ash" Ospreys, and so on, as the case may be.

But "artificials" are manufactured, in a sense, by manipulating the feathers of birds other than Herons, so as to produce what is at best a crude resemblance to the real plume. Probably the majority of these are made of what are known in the trade as "Vultures'" feathers, which are really the quill or "flight" feathers of the Rhea or South American Ostrich. The method of preparing them is interesting. The shaft of the quill is split down the centre, so that one half of the "vane" of the feather adheres to each half of the stem (fig. 3). By spirally twisting this stem (fig. 4), the barbs forming the right or left side of the "vane" of the feather are made to form a series of long, slender filaments spirally arranged around a central shaft. The effect produced, though graceful, is really quite different to that of *the* "Osprey" (fig. 1). Moreover, the whole plume is heavier in appearance. Feathers so treated are sold as artificial, and there is enough truth in the statement to be really

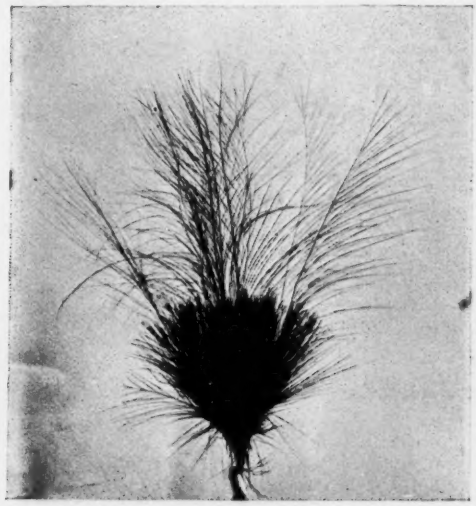


Fig. 2.—An osprey plume as sold at the milliners. In this case the plume has been dyed black. It is made up of two portions—a few valuable tips stuck into a bunch of stumps—*i.e.*, "Egret" plumes, from which the tips have been removed.

dangerous—dangerous inasmuch as whether sold as artificial "Ospreys" or as "Vultures'" plumes, the slaughter of Rheas is encouraged. Indeed, the extinction of this bird, in a wild state, seems to be rapidly approaching. Annually slain by thousands for the sake of its feathers, this Rhea has already been extirpated from much of country it formerly inhabited. That this should be so is deplorable, for the Rhea is a bird of the utmost scientific interest and importance.

An equally crude imitation of the real "Osprey" is made by treating Peacocks' feathers in the same way as that just described in the case of the Rhea.

But obviously the stump ends of real Egret feathers, or the split and spirally twisted feathers of the Rhea and Peacock, *cannot be called artificial* feathers. But what is one to do? some of my readers may ask. How can the Egret feathers be distinguished from those of the Rhea or Peacock? Do not try. Firstly, this is the work of an expert; secondly, the sale of the imitation "Osprey" does but encourage the slaughter of another species. If the Egret is spared, the Rhea must die.

XUM

It should be made a punishable offence to sell feathers under the designation of "artificial," for thereby incalculable harm is done, and women are again and again made parties to a traffic they abhor. True, some do not care; but many do. To sell feathers of any kind as artificial is to obtain money by fraud. A man can no more be justified for selling as artificial that which is real, than for selling chalk and water as milk.

To give an idea of the appalling waste of life which the trade in "Ospreys" is responsible for, we may remark that in London alone, last year, the produce of 196,000 birds was sold! As many were probably sold in the markets of Paris and Berlin, since London no longer has the monopoly of the feather trade.

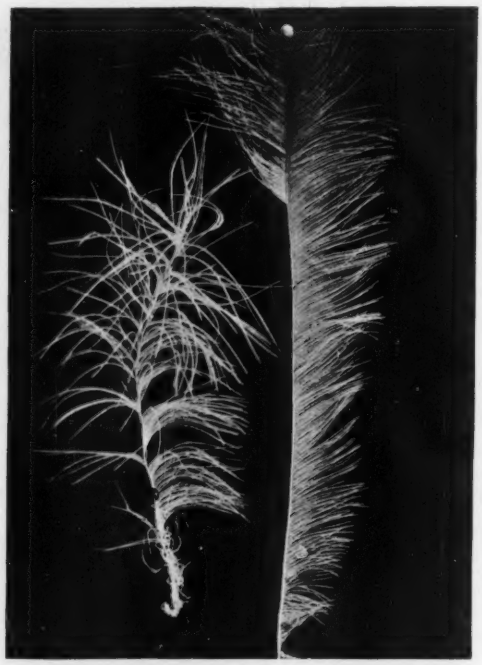


Fig. 3.—Portion of a quill feather of a Rhea. From the left side a large piece of the stem has been cut. By twisting this round, the barbs become isolated and simulate, crudely, the "osprey" plume. Such plumes are sold in the shops as "imitation ospreys," or as "vultures'" feathers.

Unfortunately for the Egrets, these feathers are worn only during the breeding season, and by both sexes. As a consequence the slaughter of the adult birds at this time ensures the death by slow starvation of thousands of young. Really the prosecution of such butchery is devilish; but what shall be said of those who, knowing this, yet purchase these ghastly trophies? To write temperately on this aspect of the subject is difficult. The accounts published by Mr. W. E. D. Scott, an American ornithologist of the highest standing, are positively sickening. Yet he purposely refrained from making anything but the baldest statements of fact; so much so, that those who do not know him, as the writer does, might accuse him of callousness. In his investigations, made in 1886, into the condition of some of the Bird Rookeries of the Gulf Coast of Florida, he found that since his last visit, six years previously, whole colonies of birds, numbering in their palmy days many thousands of individuals, had been absolutely wiped out by "plume-hunters." These ghouls travelled in bands of sometimes as many as 60 in a band. Let me quote two or three passages from his paper as a sample. Visiting the breeding place of the reddish Egret in Charlotte Harbour, he writes: "This had evidently been only a short time before a large rookery. The trees were full of nests, some of which still contained eggs, and hundreds of broken eggs strewed the ground everywhere. . . . I found a huge pile of dead, half-decayed birds lying on the ground, which had apparently been killed for a day or two. All of them had the 'plumes' taken with a patch of skin from the back, and some had the wings cut off. . . ." Again: ". . . the extermination of a Brown Pelican Rookery . . . is a very fair example of the atrocities that have been and are still being committed to obtain 'bird plumes.' . . . One afternoon, when Johnson (his informant) was absent from home, hunting, the old Frenchman (A. Lechevallier) came in with a boat and deliberately killed off the old birds as they were feeding their young, obtaining about one hundred and eighty of them. The young, about three weeks old, to the number of several hundred at least, and utterly unable to care for themselves in any way, were simply left to starve to death in their nests, or eaten by raccoons and buzzards."

One feels sorely tempted to add to this catalogue of crime if only in the hope that it may stir up some compunction in the minds of those directly concerned. Nowadays, unfortunately, we have become saturated with a spirit of scepticism, which is nowhere more injurious than in questions of this kind. "But is it not all horribly exaggerated? It really can't be true, you know!" is the cry of some to whom I have related these horrors. Others shrug the shoulders and say: "We really must not be sentimental; let us set to work, quite dispassionately, and collect evidence." And there they leave the matter!

Statements have appeared from time to time to the effect that Egret farms, on the lines of Ostrich farms, have been started both in Tunis and in America. The American farm was visited some time since, and found to consist of half-a-dozen birds in a small cage in a back yard. A detailed and glowing description was published in a German paper in 1896 of the success which had attended the establishment in Tunis. But the statement that the birds were fed on the carcases of horses, mules, and donkeys, aroused one's suspicions, and these are confirmed by the assurance that the birds are deplumed *twice* a year. The long plumes, as a matter of fact, are worn *only* during the breeding season, and therefore the story of the double crop proves too much. After careful enquiry, I cannot find that there is a shadow of truth in any part of the story. But it has caused much mischief, since plumes have been sold as the product of such farms.

Buyers of these feathers in milliners' shops are often told that the feathers are not plucked from the bird at all, but picked up off the ground. It is probably true that here and there a moulted feather is picked up in fair condition, but these can always be recognised by their soiled state and brittleness. They are useless for decorative purposes. Though normally white, these plumes, it should be remarked, are often dyed, but that does not make them "artificial."

From the illustrations to this paper there can be little difficulty, really, in distinguishing the "Osprey" plume, taken from the Egret, from the imitation "Osprey" made of Rhea feathers, or from the feathers of the Peacock. Undoubtedly, and unfortunately, the Egret plumes are the more graceful. Were this not so, one might hope to persuade those who consider feather ornaments of this kind necessary, to adopt the wearing of Rhea feathers, if

it can be shown that these birds can be farmed at a profit, as in the case of the Ostrich. So far, however, all endeavours to start a new industry of this kind appear to have ended in failure.

It is to be hoped that even imitation "Ospreys" will be eschewed in future, until some substitute for real feathers can be found which will possess the airy grace of the genuine "Osprey," or until they are made of feathers taken from birds bred for this purpose, or from some domesticated species. As it is, the good resolution

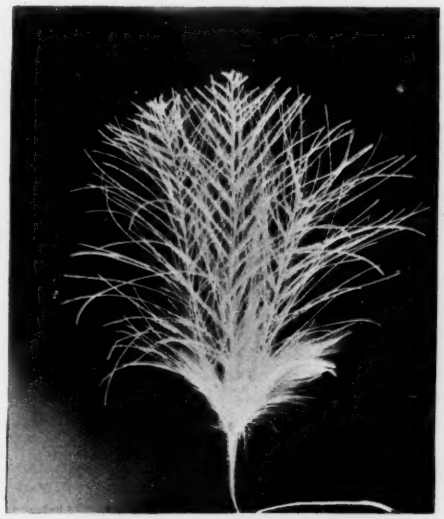


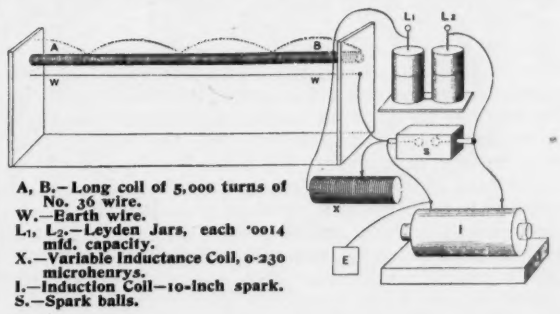
Fig. 4.—An "imitation osprey" as sold in milliner's shop; said to be made of vultures feathers. It is really made by splitting and twisting feathers of the Rhea, or South American Ostrich.

to wear only imitation "Ospreys" would create as much mischief as the wearing of the genuine plume, since the species called upon to furnish the "imitation" would themselves sooner or later suffer extermination.

Finally, "Imitation Ospreys" are simply made by using the feathers of other birds, and up to the present time these have been of wild birds. The statements that imitation or artificial Ospreys are made of split quills, whalebone, or other material, are all *absolutely false.*

Electric Wave Measurement.

DR. J. A. FLEMING, F.R.S., exhibited at the Royal Society Soirée a very ingenious and interesting device for the measurement of electric wave lengths. The principle of the method will be grasped by anyone who has watched sea waves impinging against and rebounding from a sea wall. The returning waves sometimes reinforce and sometimes neutralise the oncoming ones, so that here we have a wave crest raised above its fellows, and there a wave neutralised or eliminated. If the waves were all quite regular, and were uniformly propelled and reflected, these points of reinforced and eliminated waves would be fixed. We should in short have "nodes" and "loops" of force in the train of waves. Dr. Fleming's apparatus for showing the nodes and loops of an electric train of waves consisted of a spiral of fine wire, along which the discharge of two Leyden jars propelled vibrations varying in number between a quarter of a million a second. The resultant electric wave travelled along the spiral at about fifteen hundred miles a second, was reflected and returned, thus establishing on the wire stationary electric waves, just as stationary aërial waves are produced in an organ pipe. The position of the nodes and loops was ascertained by use of a series of carbonic dioxide vacuum



A, B.—Long coil of 5,000 turns of No. 36 wire.
W.—Earth wire.
L_1, L_2.—Leyden Jars, each ·0014 mfd. capacity.
X.—Variable Inductance Coil, 0-230 microhenrys.
I.—Induction Coil—10-inch spark.
S.—Spark balls.

tubes, which glowed when near a loop—the point where the oncoming and returning waves joined to produce a region of maximum electric force. Some further details of the apparatus are as follows:—

The long solenoid of silk covered wire has 5000 turns and a total length of 643 metres. This solenoid has parallel to it an adjustable earth wire and a divided scale. The solenoid is connected to one point on an oscillatory electric circuit consisting of a couple of Leydens having a capacity of 0·00068 mfd. and an adjustable inductance of 0 to 230 microhenrys and a silent discharger. When oscillations are set up in this circuit by induction coil discharges, and the frequency adjusted, stationary electric waves are set up in the solenoid.

The position of the first node is always well defined. Theory indicates that the distance from the end of the solenoid to the first node should be to the distance between the first and second nodes in the ratio of 1 : 2·5, and that the distance between the first and second nodes should be half a wave length. Experiments with this apparatus give a mean value of 1 : 2·4 for the above ratio for the first five odd harmonics.

The inductance of the long spiral is 100 microhenrys per centimetre of length and its capacity is 26×10^{-8} of a microfarad per centimetre of length. From these data the velocity of the wave along the spiral is found to be about 196 million centimetres per second.* From the wave lengths experimentally determined the corresponding frequencies are then found, and these agree substantially with the frequencies as calculated from the inductance and capacity of the Leyden jar circuit that is employed. Thus, corresponding to the first odd harmonic the node is 64 centimetres from the end. The inductance in the jar circuit is then 79 microhenrys, and the frequency as determined from the node-position and wave-velocity is 720,000 complete oscillations per second; whilst from the jar circuit inductance and capacity it is 690,000, or in fair agreement. The practical interest of the apparatus lies in the fact that it is in actual use for measuring the lengths of wireless electric waves such as are sent out from the station at Poldhu, in Cornwall.

* Frequency $= \frac{5 \times 10^6}{\sqrt{\text{Capacity of Jar in microfarads} \times \text{Induction of Coil in c.m.s.}}}$

See Dr. Fleming's Cantor Lectures, 1900.

The International Association of Academies.

THE chronicle of scientific movements of the past month would be incomplete without a record of the meeting in London of the General Assembly of the International Association of Academies, an event which brought together a singularly noteworthy gathering of men of science and of letters. An assemblage of such cosmopolitan and select character as this was, comprising the representatives of the premier academies of the world in the departments of knowledge, had not hitherto been seen in the metropolis. We have been privileged to receive and welcome from time to time the various foreign deputies to the peripatetic meetings of the British Association, as well as those attending the meetings of chemical, medical, and allied learned bodies, but never a congress of the world's academies. This necessarily stands on a plane distinct from composite gatherings held under auspices such as the above mentioned, responsible though they be in themselves, and worthy of all respect.

The reason lies upon the surface, and is easy to state. An amalgamation of academies strikes a new note, for it is based on the wider authority that may be derived from international co-operation, regularly organised, and made applicable to the advancement of learning in its broadest aspects. Here is an effort to open up useful avenues of knowledge, and break untrodden ground under the stimulating influence of a common purpose. And what of the need for an organisation possessing these aims and characteristics? The answer is that its inception is the actual and perceptible response to aspirations long entertained by men of science and learning of various countries. It may be recalled that Sir Michael Foster, at the Dover meeting of the British Association in 1899, uttered these weighty words:—"No feature of scientific inquiry is more marked than the dependence of each step forward on other steps which have been made before. The man of science cannot sit by himself in his own cave weaving out results by his own efforts, unaided by others, heedless of what others have done and are doing. He is but a bit of a great system, a joint in a great machine, and he can only work aright when he is in touch with his fellow-workers."

From general considerations of this nature, reference may pass to the initial steps that led ultimately to the foundation of what is now denominated the Association of Academies. Germany, the home of the greatest of all academicians, Leibnitz, had zealously fostered for many years a union of the Royal Societies of Göttingen and Leipsic, in collaboration with the academies of Vienna and Munich, called a "cartell." This met annually, turn by turn, at convenient centres for the purpose of discussing matters of science and learning in which a partnership of effort was beneficial for the several ends in view. It so happened that the scheme of the Royal Society of London (now in active operation) for the promotion of a universal and continued catalogue of scientific literature on an international basis was one of the subjects submitted to the cartell at its meeting at Göttingen in the year 1899, at which, it should be mentioned, English representatives were present by special invitation. The latter, however, at the time, had been coupled with the expression of a wish that the Royal Society would consider the question of itself joining the cartell. To this cordial and significant desire for an extension of the boundaries of the cartell's sphere of work—it could mean nothing else—the delegates were empowered to say that the Society was disposed to join if the principle of a plan for the founding of an international combination of the more important societies and academies of the world was conceded, and, in fact, made the objective. The little set of foreign academies agreed, and the next move forward lay in the calling of a conference at Wiesbaden in the same year, to consider the general agreement previously arrived at, and to discuss the lines of establishment of the amalgamation thus forecasted. Here it is not out of place to recall that the English delegates on this occasion were Sir Arthur Rücker, Professor A. Schuster, and Professor H. E. Armstrong.

It is beyond the limit of our space to fully detail the subsequent and steadily progressive history of the movement for an international alliance. Statutes and laws were, however, formulated, and one by one the adhesion of the greater societies and academies of the world was obtained. The appointment of an international council was ratified, whose duty it should be to conduct the business of the Association in the intervals of the triennial meetings of a plenary General Assembly, such as that which has just concluded its deliberations. Further, the decision was taken that the first gathering of the latter body should be held in Paris in 1901—an event which virtually marked the birth of the International Association. To M. Gaston Darboux, the distinguished Permanent Secretary and *doyen* of the Academy of Sciences of Paris, fell the privilege of acting as President. By a unanimous vote London was then chosen as the venue of the next Assembly.

The delegates who have attended the Congress represented the full complement of constituent academical bodies, and were drawn from the cities of Amsterdam, Berlin, Brussels, Budapest, Christiania, Copenhagen, Göttingen, Leipsic, London, Madrid, Munich, Paris, Rome, St. Petersburg, Stockholm, Vienna, and Washington. In the case of London, the Royal Society delegation was composed of eighteen Fellows, including Sir William Huggins, its venerable President; while the British Academy, which is now, of course, within the pale of the Association, was represented by Lord Reay, the President, and six other Academicians. Among notable foreign men of science and of letters present were the Count de Franqueville, M. Moissan, Señor José Echegaray, President of the Royal Academy of Sciences of Madrid, Dr. Viktor von Lang, of Vienna, Count Balzani, and Prof. Svante Arrhenius, the eminent Swedish chemist.

Among the subjects that have been under consideration during the Congress may be mentioned a scheme for carrying on magnetic observations at sea, with the view of establishing a comprehensive magnetic survey around a parallel of latitude—a project requiring international co-operation to be completely successful. Seismological and geodetic investigations were under discussion—domains of inquiry in which scientific men of various nationalities are just now much interested. The British Academy promote a scheme for a lexicon of the Greek language; the Academies of Copenhagen and Berlin put forward a plan for a Corpus Medicorum Antiquorum. Then the important question of the establishment of an institute for the purpose of investigating the anatomy of the brain was under reference—a subject on which great unanimity prevails among foreign and English men of science. The above are instanced merely to indicate a few of the matters of scientific and literary interest that are before the Association in some stage or other.

XUM

The labours of the plenary Assembly were lightened during the period of meeting by a series of hospitalities planned by the Royal Society, the Lord Mayor, the University of London, and a number of representative men of science; those carried out by the last-named being of a particularly cordial and pleasant nature. In addition, the Universities of Oxford and Cambridge arranged visits, and the conferment of degrees upon certain of the foreign delegates took place.

REVIEWS OF BOOKS.

Aeronautics.—"My Airships," by A. Santos Dumont (Grant Richards; 6/- net), is not a student's book. It is a popular work, and it does not, even when judged by this modest standard, afford very much more information than the diligent newspaper reader might have gleaned from the files of the daily papers. It is prolific in anecdotes of M. Santos Dumont's adolescence, and it is charmingly illustrated by photographs of all his flying machines and most of his accidents. These photographs are indeed the most valuable feature of the volume, and furnish an idea of the evolution of the navigable form of airship, or balloon. M. Santos Dumont does not furnish any positive data as to the exact speeds at which he has been able to drive his ships; but he assumes that they travelled at a higher rate than that which Sir Hiram Maxim, for example, thinks that an airship of the balloon type can be driven. "When, therefore, I state that, according to my best judgment, the average of my speed through the air in those flights (flights with No. 6 in 1902) was between 30 and 35 kilometres (18 and 22 miles) per hour, it will be understood that it refers to speed through the air whether the air be still or moving, and to speed retarded by the dragging of the guide rope. Putting this adverse influence at the moderate figure of 7 kilometres (4⅓ miles) per hour, my speed through the still or moving air would be between 37 and 42 kilometres (22 and 27 miles an hour)." If this can be taken as trustworthy then there seems to be not the slightest reason why M. Santos Dumont should not "lift" the Grand Prize of $100,000 which the St. Louis Exposition is offering for the best average times made over a fifteen-miles triangular course, provided that the average speed is not less than 18⅔ miles an hour. Two points are specially to be noted about M. Santos Dumont's method and the possibilities he claims for it. One is that he is never foolhardy, and keeps as close to the ground as he can, since nothing is to be gained by height. The other is that he maintains that the chief difficulty in driving against the wind is not the "push" against the front of the balloon ship, but the suction or pull at its stern. The defect of the compilation is chiefly one of omission. One might well imagine after reading "My Airships" that M. Santos Dumont alone had done anything worth recording in the sphere of balloon propulsion. A few allusions are made to M. Giffard's unproductive experiments of fifty years ago, but the very successful achievements of MM. Renard and Krebs, who practically accomplished almost as much as M. Santos Dumont has done, are merely referred to as "the trials of such balloons . . in 1883 had been repeated by two constructors in the following year, but had been finally given up in 1885." And yet he says: "Before my experiments succeeded, were they not called impossible?" Moreover, no allusions whatever seem to be made to the Lebaudy balloon, which, according to all accounts, has surpassed the author's machines in speed, in distance travelled, and in the number of successful return trips.

Geology.—Messrs. Blackie and Son have published a fifth edition, revised, of Mr. Jerome Harrison's "Text-Book of Geology." It is an admirably compact text-book in its present form; the new photographs are as welcome as they were necessary; and the addition of a table showing the range in time of invertebrate fossils is extremely and distinctively useful.

Builders' Quantities—Mr. H. C. Grubb has written "Builders' Quantities" (Methuen and Co.) with the intention of giving sufficient and necessary information to technological students for the City and Guilds examination on the subject, and to candidates for the Board of Education examination on Building Construction. The book is eminently practical, and is not without acute interest for those whose dealings with builders consist solely in paying their bills.

Radium. "Radium, and All About It" (Whittaker and Co.), by S. R. Bottone, is a cheap handbook which does not justify its subsidiary title. It is, none the less, a handy summary of the more popularly interesting facts about radium, and it adds a rather hasty summary of some of the theories concerning radium activities, ending with the doubts cast by Sir W. Huggins' examination of the spectrum of radium on its final degradation into helium.

Entropy. Mr. James Swinburne repeats in "Entropy" (Constable) those views on thermodynamics which he has been repeating with considerable satisfaction to himself both before and since he read his disturbing paper on the "Reversibility of Thermodynamics" to the Physical Section of the British Association last year. Since its publication it has been denounced by the chief opponent of Mr. Swinburne's views as likely to be extremely disturbing to earnest engineering students; but it has at any rate been productive of some interesting and spirited rejoinders from Professor Perry. As an example of Mr. Swinburne's lively style, we may quote the following passage: "The unit of heat, which is quite an unnecessary nuisance, has no name, for British thermal unit is not a name; it is an opprobrious epithet."

"Metal Working," by J. C. Pearson (John Murray; 2s.), is an admirable guide to the practical manipulation of tools for the working of metals. The subjects treated of are divided under the various headings, such as "Filing," "Scraping," "Soldering," "Riveting," &c., and each operation is not only clearly described, but good outline figures and numerous photographs add greatly to the value of the descriptions, so that any one mastering this little work may consider himself a fairly expert metal worker.

BOOK NOTICES.

Flowering Plants and Ferns. A second edition of the "Manual and Dictionary of the Flowering Plants and Ferns" (Cambridge University Press; 10s. 6d.), which Mr. J. C. Willis originally wrote in two volumes, has now been published in a single volume to its great advantage in accessibility of information and general usefulness. Mr. Willis's work, modest in aim, and described by its author as a mere compilation, is of encyclopædic value to the student of botany. As in the first edition, its staple contents are a dictionary in which the whole of the families and the important genera of flowering plants are dealt with; and this general information is supplemented by special treatment in Part I. of the morphology, natural history classification, geographical disposition, and economic uses of the flowering plants and ferns. To the new edition has been added a mass of additional material; and new features are the articles on outfit, on collecting and preserving material, on observing and recording, and on general field work—a method of botanising which receives too little attention. We cannot pay the work a higher compliment than that of saying that Mr. Willis's expressed aim "to render the work sufficiently complete for the requirements of botanical students, schoolmasters, travellers, residents in outlying districts, and the considerable class of people who have an indirect interest in botany, and need some general work of reference on that subject . . ." has been completely and triumphantly attained. At the same time the student at home will be able to make constant use of it as a treatise of reference in general morphology and geology on plant distribution and systematic botany.

War in the Far East.—We have received from Messrs. Virtue and Co. for review the first volume of a history of the Russo-Japanese War, "War in the Far East," by E. Sharpe Grew. Vol. 1, which is attractively bound and illustrated, deals with the preliminary history which led to the outbreak of war. The evolution of Modern Japan is traced; the relations of Japan with Korea and China are described, and an account is given of the Chino-Japanese War. It is shown how the intervention of European Powers in the settlement of Peace negotiations and the subsequent Russian encroachments led inevitably to the present crisis in the Far East.

XUM

MICROSCOPY

Conducted by F. SHILLINGTON SCALES, F.R.M.S.

MITES.

CECIL WARBURTON, M.A.

(*Continued from page* 105.)

AND now, perhaps, a somewhat more detailed account of the animals we are looking for may not be out of place. That they are not insects, but arachnids, is doubtless perfectly well known to readers of "KNOWLEDGE." They are without antennæ, and have normally eight legs when mature. The Oribatidæ are blind, but when eyes do occur in the mite tribe they are simple and not compound. The Arachnida of this country are represented by the spiders, the harvestmen, the "false-scorpions," and the mites. The false-scorpions, or Chelifers, are unmistakable, and the spiders are distinguishable at a glance from the mites because of the narrow pedicle or "waist" which joins the two portions of their body. The characters which separate the mites from the harvestmen are not quite so obvious, but the latter have the abdomen more or less distinctly segmented, and have always two eyes on a turret in the middle of the fore-part of the body. In practice there is little danger of confusing the two groups, as very few mites, except the easily recognised ticks, are equal in size to the smallest British Phalangids or harvestmen. All mites live on fluid nutriment, some deriving it from animals, others from plants, and their mouth parts are accordingly adapted for piercing and sucking. It will be useful, perhaps, to give in this place a short review of the principal acarine groups, and to indicate in a few words the general condition of our knowledge with regard to them.

First of all, then, we have two families of very minute worm-like mites, the Eriophyidæ (or Phytoptidæ) and the Demodicidæ. The former are generally known as gall-mites, and are responsible for various plant diseases, a familiar example being the disease of "big bud" in black currants, which is caused by *Eriophyes ribis*. The Demodicidæ are animal parasites, and the best-known example is *Demodex folliculorum*, parasitic in the hair follicles of man. Then follow the Sarcoptidæ, or itch-mites, extremely unattractive creatures, which are external parasites of various vertebrate animals. All the above, possessing a certain economic importance, have necessarily attracted more or less attention from those who study the diseases of animals and vegetables, but from the faunistic point of view there is much ignorance with regard to them in this country. For further information we may refer the reader to Neumann's "Parasites of Domesticated Animals," which has been translated by Dr. Fleming, and to Connold's handsome volume on "British Vegetable Galls."

We next come to the Cheese-mite tribe or Tyroglyphidæ, which feed chiefly on decaying animal or vegetable matter. They are a small group of soft-bodied mites, generally white in colour, and the British species have recently been monographed by Michael in the publications of the Ray Society. Then follow the Oribatidæ, with which we are principally concerned in the present paper, and they are succeeded by the ticks or Ixodidæ. Though their comparatively large size has probably made the ticks the most familiar examples of mites to the uninitiated, yet we are only beginning to know something about them, and recent investigations in their direction are again entirely due to their economic importance as the medium by which various dread diseases are communicated to man and domestic animals—chiefly in foreign countries. Neumann's "Parasites" may again be consulted, and the same author has written a Revision of the Ixodidæ, but the British ticks are only very slightly known.

The same may be said of the Gamasidæ, free-living predaceous mites, examples of which are sure to be found among the moss in which we are seeking the beetle mites. They run rather quickly and use their long front legs chiefly as feelers. A serious attempt to deal with the British species is very much to be desired.

Other families of free-living mites, also clamouring for attention, are the Bdlellidæ or snouted-mites, and the Hydrachnidæ or fresh-water mites, and then we come to the Trombidiidæ, which include the velvety scarlet "harvest mites," and the Tetranychidæ or spinning mites, a familiar example of which is the "red spider," so obnoxious to fruit growers. Almost the only English work which professes to deal with these groups is Murray's British Museum hand-book entitled "Economic Insects —Aptera," a book necessarily long out of date, and not free from grave errors. It is abundantly clear, therefore, that much remains to be learnt with regard to the British Acari, some families of which are practically untouched by any recent investigator.

And now for a few final words concerning the Oribatidæ, which afford in many respects the best introduction to the study of the mite tribe. Four stages are distinguishable in the life-history of these mites—egg, larva, nymph, and imago. In some species the transformation or metamorphosis is very complete, there being hardly any resemblance between the nymph and the imago, while in others the change is not so striking. The eggs are relatively very large, and the larvæ which hatch out may be recognised as such by the fact that they possess only six legs. The fully-grown creatures are generally slow moving, and with hard or leathery integuments. Their body is usually pretty clearly marked off into two regions, the cephalothorax and abdomen, though only in one genus, *Hoploderma*, are these capable of independent movement. Whether a mite is an oribadid or not may be readily determined by examining the cephalothorax, for in this family there is always present a pair of curious sense organs known as *pseudostigmatic organs*. They are modified hairs, of varying shape, proceeding from the centre of two circular pits with raised edges situated near the sides of the hind part of the fore-body, near the commencement of the abdomen. Their peculiar shape and disposition are of prime importance in determining the species of one of these creatures. In the nymphs the legs always terminate in a single claw, but the imagos may be either monodactyle or tridactyle. The nymphs moult three times before the mature stage is reached, but in some cases the cast skins are never entirely thrown off, and the adult mite walks along with the three nymphal skins still adhering to its back.

These mites differ very much in the general appearance they present, some being smooth, glossy, and beetle-like, while others have a rugged, leathery appearance and are furnished with warty prominences, or bristle with hairs and spines. Some of the more hairy species have a remarkable habit which is a distinct nuisance to the collector. They cover themselves—doubtless for pro-

tective reasons—with particles of dirt, which entirely alter their appearance, and are by no means easy to remove completely, and these grotesque moving particles of dust and *débris* have to undergo very rigorous ablutions before they are ready for the cabinet.

Royal Microscopical Society.

April 20.—Dr. Hy. Woodward, F.R.S., Vice-President, in the chair. A large tank microscope, made by Thomas Ross, presented to the Society by the Committee of the Quekett Microscopical Club, was exhibited. It was made not later than the year 1870, and was designed for the purpose of examining objects contained in aquaria. It was a beautifully made and highly-finished instrument, having nearly every conceivable adjustment. The annual exhibition of Pond-Life was given this evening by Fellows of the Society, assisted by members of the Quekett Microscopical Club.

Quekett Microscopical Club.

The 413th ordinary meeting of the Club was held on April 15, at 20, Hanover Square, W.—the President, Dr. E. J. Spitta, V.P.R.A.S., in the chair. A paper was read by Mr. W. Wesché, F.R.M.S., "On some new Sense-organs in the Diptera." The paper was well illustrated by diagrams and drawings. After briefly reviewing the investigations of Packard, Platten, Forel, Lubbock, and others into the senses of taste, smell, and hearing in insects, the author proceeded to show that he had found processes homologous with the "taste-hairs" of Kraepelin in some Orthoptera, Coleoptera, Diptera, and Hymenoptera. Organs were then figured on the antennæ of *Gastrophilus equi*, L., *Stratiomys chameleon*, L., and *Bibio hortulanus*, L., which were thought to be typical olfactory organs. Both the antennæ and palpi of insects were considered capable of receiving the stimulus of several senses, but their capacities differed so much in various genera and species that a general rule could not be formulated. The author had found new sense organs on the femora of many Diptera which he was unable to assign to any sense of which we have conception. Other organs of quite different construction had been found on the tibiæ of some minute Empidæ. Their functions were quite unknown, and several experiments which had been made with a view of discovering the functions had yielded only negative results.

Journal of the Quekett Club.

The April number of this Journal, which has just reached me, contains several useful articles and notes, amongst which are a note by Mr. F. J. Cheshire concerning Abbe's test for aplanatism, and a simple apertometer derived therefrom, the apertometer being figured on a separate plate, so that it can be cut out and used on the microscope in the way described by the author. Mr. F. P. Smith, the new Editor of the Journal, contributes a note on the spiders of the sub-family Erigoninæ; Mr. Rheinberg a note on an overlooked point concerning the resolving power of the microscope; and Mr. Scourfield concludes his synopsis of the British fresh-water Entomostraca, including the Ostracoda, Phyllopoda, and Branchiura.

Microscopic Slides.

In the advertisement columns of this magazine will be found a notice relating to the sale of duplicates of slides from the collection of Mr. J. Hornell, of Jersey. Many of my readers will be familiar with these beautiful preparations, which include botanical as well as zoological subjects, and as they are now being dispersed, and are offered at quite nominal prices, I have felt myself justified in calling attention to them.

Practical Botany and Geology Classes.

I have been much interested in receiving from Mr. J. M. B. Taylor, Curator of the Free Museum at Paisley, particulars of field rambles held in that neighbourhood from April till the close of the public schools in July, with a view to giving students a practical acquaintance with nature. The plan is excellent, and well worth being taken up by other of our many Free Libraries. Excursions are held twice a week, namely on Wednesdays and Fridays, leaving Paisley at 5.40 p.m., or such other time as may be agreed upon, many of the excursions being in brakes so as to get well into the surrounding country. For the last five or six years during each session the class has brought in from its field rambles the typical wild plants, grasses, ferns, &c., of the time and district, and these have been placed on view in the Free Museum with their English and scientific names attached. Fresh specimens of plants were added twice weekly, and lists thereof published in one of the local daily papers. Nature knowledge was studied practically at these excursions with the help of the camera, a portable microscope, and a dredge for streams and ponds. At the New Year a four days' exhibition was also held. By the kindness of a local lady, Mrs. Polson, of Leven Castle, prizes of microscopes were offered to the members of the class for the best collection of dried, mounted, and named wild plants, grasses, and ferns; and a microscope was likewise offered to working men and women who would also make a dried collection, with names (which were obtained from specimens shown in the Museum), but who were not members of any class or Natural History Society, where names of plants were given. This prize was gained by an ex-mason. For members of the class each collection had to contain 400 specimens; and for the collection made by working men and women there must be 200 specimens. It is to be hoped that so excellent a scheme may find many imitators.

Notes and Queries.

Chrysanthemum Fungus. (C.H.C.)

I have submitted the chrysanthemum leaves to Miss E. M. Gibson, who has for some time been investigating this fungus in the Cambridge University Botanical Laboratories. I learn from her that it is quite a new species, having only been discovered some six or seven years ago, and has been described, as far as present knowledge allows, by Dr. Ernst Jacky, in the *Zeitschrift f. Pflanzen-Krankheiten*, Vol. X. (1900). It has been tentatively named "Uredo-chrysanthemi," but though Mr. Massee, in the *Gardener's Chronicle* speaks of other stages teleuto or aecidio spores have not hitherto been definitely found, or at least the evidence is not complete. Miss Gibson says she has herself quite failed to find any other stage than the uredo spores, as on the leaf you sent me. Apparently the fungus, though unquestionably injurious, is not necessarily destructive to the plants, but various species living under similar conditions, show a curious variation in susceptibility to attack, especially under high cultivation. So far the conditions favourable or otherwise to the fungus have also not been determined.

Making Rock Sections.

Mr. C. H. Caffyn, of Hornsey, writes with regard to rock sections: "I tried to make sections, as recommended in the text-books, with emery powder on a piece of zinc or glass, but it was a very long job, and the results were not altogether satisfactory, and were quite out of proportion to the time employed. I then thought it could perhaps be done with ordinary emery cloth, and I find this does very well, and takes much less time. I first chip off as thin a flake as possible, and grind one side flat on 'F' emery cloth. Then I use No. 1 and then No. 0, and then polish on a piece of No. 0 that has been rubbed down with a bit of itself to take the surface off. The piece of rock is then stuck on a bit of plate glass with ordinary mucilage—I use Stephen's gum. When dry, the rock can be rubbed down as mentioned above. Great care must be taken when rubbing on the No. 0 to finish, as the section is apt to crumble at the edges. When it is thin enough (which I generally judge by reading print through it), put the piece of glass and section in ordinary water till the section floats off the glass. Then wash with a sable brush to remove all gum. Soak in methylated spirit to remove water. Evaporate spirit, soak in benzene, and mount in balsam and benzole." Mr. Caffyn has sent me some slides to look at which have been made in this way, and which seem quite equal to those made by the ordinary process.

[*Communications and enquiries on Microscopical matters are invited, and should be addressed to F. Shillington Scales, "Jersey," St. Barnabas Road, Cambridge.*]

XUM

The Face of the Sky for June.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 3.51, and sets at 8.5; on the 30th he rises at 3.48, and sets at 8.18.

The sun enters the sign of Cancer on the 21st at 9 p.m., when summer commences.

The equation of time is negligible on the 14th.

Sunspots have been very conspicuous of late, whilst in addition spectroscopic observations of the Sun's limb have shown many fine prominences.

The positions of the spots with respect to the equator and axis may be derived from the following table:—

Date.	Axis inclined to W. from N. point.	Centre of disc, N of Sun's equator.
June 5 ..	13° 54′	0° 3′
,, 15 ..	9° 45′	1° 15′
,, 25 ..	5° 21′	2° 25′

THE MOON:—

Date.	Phases.	H. M.
June 6 ..	☾ Last Quarter	5 53 a.m.
,, 13 ..	● New Moon	9 11 p.m.
,, 20 ..	☽ First Quarter	3 11 p.m.
,, 27 ..	○ Full Moon	8 23 p.m.
June 5 ..	Apogee	11 24 a.m.
,, 17 ..	Perigee	0 30 p.m.

Occultations.

The particulars of the only occultation likely to be observed during the month are as follows:—

Date.	Star's Name.	Magnitude.	Disappearance.	Reappearance.
June 24	θ Librae	4·3	11.55 p.m.	0.30 a.m. (25th)

THE PLANETS.—Mercury is a morning star in Taurus, he is at greatest westerly elongation on the 8th, when he rises about an hour in advance of the sun.

Venus is a morning star, but too near the Sun for observation.

Mars is in conjunction with Venus on the 19th, and therefore also out of range.

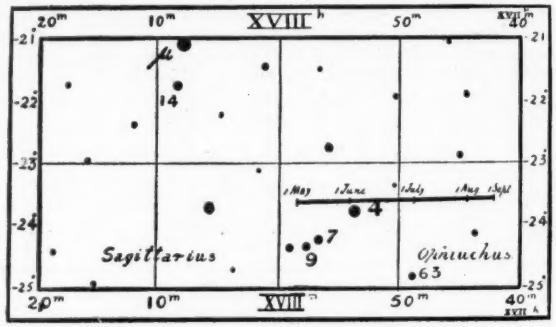
CERES.—The minor planet Ceres is in opposition on the 5th, when the magnitude is 7·4. On this date the asteroid has the same declination as the star ξ Ophiuchi but is oh 18m 41s west of the star.

Jupiter is a morning star, rising about 1 a.m. near the middle of the month.

Saturn is in the eastern portion of Capricornus near the star δ; the planet is at the stationary point on the 1st, after which date his motion is retrograde.

On the 1st Saturn rises about midnight, and on the 30th about 10.15 p.m. The northern surface of the ring plane is presented to us.

Uranus is in opposition on the 19th, hence about this date he is on the meridian at midnight. The apparent diameter of the planet is 4″. In consequence of his low altitude, it is rather difficult to see the planet with the naked eye, but any slight optical aid renders him easily visible. The appended chart shows his position in Sagittarius.



PATH OF URANUS IN SAGITTARIUS:—

Neptune is in conjunction with the Sun on the 27th, and consequently is unobservable.

Comet α 1904. About the middle of April the first comet of the year was discovered in Hercules by Brooks, at Geneva, N.Y., U.S.A. It is a faint telescopic object, diminishing in brightness, and is slowly moving along the borders of Draco into Ursa Major. Early in June, it should be near the star ξ Ursae Majoris.

THE STARS:—

Positions of the stars about 10 p.m.:—

ZENITH . Great Bear, *Cor Caroli*.
NORTH . Ursa Minor, Cepheus, Cassiopeia.
EAST . Lyra, Aquila, Saggittarius, Cygnus.
SOUTH . Hercules, Ophiuchus, Corona, Libra, Scorpio.
WEST . Leo, Cancer.—S.W.: Virgo and Boötes. —N.W.: *Capella*.

TELESCOPIC OBJECTS:—

Double Stars:—β Scorpii, XVI.h0m, S. 19° 33′, mags. 2·0, 4·0; separation 13″·1.

ε Lyræ, XVIII.h 41m, N.39° 32′. Quadruple star, better known as the "double-double." The star can be divided into two components ϵ^1 and ϵ^2 (mags. 4·6, 4·5; separation 207″) with the slightest optical aid and under favourable conditions the naked eye alone is able to effect separation; using a power of about 150 on a 3 or 4-inch telescope, each of these can again be divided, ϵ^1 mags. 4·7, 6·3; separation 3″·0; ϵ^2 4·9, 5·2, 2″·5.

ζ Lyræ, XVIII.h 41m, N. 37° 30′, mags. 4·3, 5·9; separation 44″. Very easy double; power 20.

δ Lyræ, XVIII.h 51m, N. 36° 49′, mags. 5·5, 5·9; naked eye double. Glorious field for low powers (*Webb*).

θ Serpentis, XVIII.h 51m, N. 4° 4′, mags. 3·9, 4·2; separation 22″. Fine pair in small telescopes.

Clusters and Nebulæ.—M80 (Scorpio). A compact globular cluster half way between α and β Scorpii; looks like a nebula in small telescopes.

M57 (Ring Nebula in Lyra). Easily found by setting the telescope ⅛ of the distance from β towards γ. Rather faint object, but readily seen as a small ring in a 3-inch; it is the only annular nebula visible in small telescopes.